Sustainable Rehabilitation of the Built Environment

The Case of Coastal Area of Zouk Mosbeh, Lebanon

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This thesis is dedicated to my wife Patricia

And my daughters Francesca and Maria Margherita

Antoine de Saint Éxupery wrote:

"*We did not inherit the earth from our parents we are borrowing it from our children*"

Abstract

This research project considers the causes and negative impact of inadequate construction standards and planning policies upon the Lebanese Coastal Zone (LCZ) environment, particularly in the area of Zouk Mosbeh (ZM), wherein commercial, residential, industrial and tourist developments and amenities intersect so haphazardly, and where a failure to raise standards and correct abuses lead to the degradation of the area.

Drawing upon previous built environment research, particularly sustainable rehabilitation, urban planning, as well as urban development in Lebanon, and focusing on the LCZ particularly on ZM, was helpful in identifying the complex relations between the various environmental problems of water, air, biodiversity, soil, and land erosion, on one hand, and the various socio-economic development sectors relating to population, agriculture, industry, and construction, on the other.

The adopted methodology approached the problem of the built environment and its impact on the biophysical environment holistically, taking into account environmental, economic and socio-cultural justice, as main dimensions of sustainable development. This was undertaken in the form of a case study on the coastal area of ZM, along the LCZ.

Recommendations in the form of guidelines for the sustainable rehabilitation of the built environment in the area of ZM were developed. These included the roles of all stakeholders in the decision-making process regarding urban development, the municipality, inhabitants, and finally built environment professionals. The literature is very robust, especially regarding the need for bottom-up participatory process where all stakeholders are involved in the

policy and implementation process. In contrast, important gaps were found, and this relates to the lack of interaction among stakeholders, especially between the municipality authority and the community on the one hand, and between built environment professionals and the rest of the community on the other. This has obvious negative implications for sustainable urban planning and development.

Additionally, this study has demonstrated the need for all built environment stakeholders in ZM and, for that matter, in all of Lebanon to commit to sustainable development principles. This commitment is imperative, as it is the only viable strategy for meeting the needs of the present generation without compromising the needs of future generations.

It is hoped that this research will contribute significantly to current debates on environmental sustainability in Lebanon, especially during this period of unprecedented physical reconstruction and development, so that the principles of sustainable development will be integrated into national plans, especially urban plans to avoid huge and future correctional expenditure.

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CHAPTER 1

1.0 GENERAL INTRODUCTION

1.1 Statement of the problem:

Fifteen years of civil war (1975-1990) and regional tension has altered the physical characteristics as well as the economic and social structure of Lebanon that was once described by Kassir as the "La Suisse de l'Orient" or the Swiss of the East (Kassir, 2003). In his observation, Lebanon was "a country of milk and honey and certainly a city of luxury and pleasures". He further noted that twenty years after independence from France in (1946), Lebanon appeared a success story, and Beirut, its capital, was widely seen as a rare pearl of the afflicted near east. This golden age lasted, albeit with ups and downs, until the beginning of the civil war in 1975, and this owes to many factors among which include:

- The entrepreneurial success of the private sector over the public sector, and this was in marked contrast with other Arab countries or cities such as, Cairo where infrastructure and services, especially those related to tourism are relatively underdeveloped.

- Huge foreign capitals were channelled into Beirut's banks, and this was mostly encouraged by the country's Banking Secrecy as well as the "laissez faire" economy. However, there are some other political imperatives as well, such as the disappearance of the Arab Palestine state in 1948, and the Syrian-Lebanese break in 1950. The latter resulted in border controls and in the institution of an ipso-facto monopoly of sea and air transit through Lebanon and the rest of the world.

- The liberal political and economic system of Lebanon during these years, in contrast with the strong political wave of nationalism in the neighbouring Arab countries made Lebanon a safer haven for regional and international financial capital and wealth deposits.

- The increase in petroleum revenue and its impact on the Arab peninsula as well as the radical break of Lebanon from Syria repositioned Lebanon in the eyes of the other Arab countries especially for its two important petroleum refineries at the time.

- Lebanon becoming the new economic hub for the rest of the Arab world, and this is illustrated by the fact that 30% of global trade in gold passed through Beirut to the rest of the Arab monarchs and sheiks.

This positive and socio-economic and political trend was brought to an abrupt end by the civil war which lasted fifteen years from 1975 to 1990, and caused severe physical destruction and socio-economic disruptions. The displacement of huge numbers of peoples of different religious and political groups imposed huge pressure on the built and the natural environment, especially the rural coastal towns and cities (Global IDP, 2004, Republic of Lebanon, 1997, and 2001). This situation was further compounded by the Israeli invasion and occupation of southern Lebanon for many years.

The end of the civil-war in 1990 and the relative reduction in regional tension has seen the gradual return to normality and no where else has this manifested most other than the built environment. As Figure 1.1 clearly shows, the built environment, in a matter of 15 war-years has changed drastically with huge construction of residential, commercial, and industrial buildings. A noticeable feature of these developments is the lack of adequate planning and development controls. This is evidenced by the typology and heights of these buildings, especially regarding their morphological contexts, which violate basic planning rules and development controls (Saab, 2004). The buildings are clustered and the lack of adequate infrastructures is endangering to the health and lives of the inhabitants (Republic of Lebanon, 1997, and 2001).

Figure 1.1

The Changing Face of Beirut

Source: El Asmar, October 2004

The reluctance of the government to enforce planning and development controls can be explained, and this derives from the war sentiments and the spirit of peace and reconciliation that have endured. However, there is the fear that when such culture becomes entrenched, it will be very difficult to reverse. The real problem is how to persuade all built environment stakeholders, including the government that building to plan, standards, and development controls hold the key to sustainable development of the Coastal Area of Lebanon.

1.2 Aims and objectives of the research:

Lebanon is undergoing what can be called an exciting period of Urban transformation. This is particularly the case given the internal civil-war and regional conflicts that continue to engulf the country. As Lebanon emerged from this crisis, there has been an unprecedented level of optimism in the economy which has manifested itself in huge commercial, residential, and industrial property development. A casual observation reveals that these

physical developments adhere to no sustainable patterns of development: houses are being built with no regards to existing laws on planning and development controls with the encroachment of buildings over natural landscapes, poor visibility, air, and noise pollution as well as water pollution have become the defining characteristics of Lebanon's coastal areas. It is desirable to try and understand the extent and dimension of the problem, and search for possible solutions. Countries in the region might also be experiencing the same situation as Lebanon and would accordingly benefit from this work.

The overall aim of this project is to analyse the nature and extent of environmental degradation in Lebanon, particularly the impact of the built environment on the physical environment. This is expected to produce a set of rules and regulations that take cognisance of all the components of sustainability, including the economic, socio-cultural, and environmental characteristics.

To achieve these aims, the following objectives are pursued:

- A critical analysis of the biophysical environment of Lebanon will be undertaken to indicate the extent to which its "carrying capacity" is being compromised.

- A critical review of Lebanon's environmental and planning laws as well as building codes and regulation and the extent to which they are adhered will be undertaken. Particular attention is paid to the pre–war and post–war Lebanon period for measure of comparison.

- The Zouk Mosbeh coastal area of Lebanon will be used as a case study: an area that is undergoing rapid process of deterioration for which rehabilitation is necessary. The problem is exacerbated by lack of appropriate infrastructure and as such requiring rehabilitation. Firstly, the multiple reasons for the deterioration and rehabilitation are visited. Secondly, efforts at rehabilitating the area are critically analysed and

shortcomings identified and discussed. Particular attention will be paid to the rehabilitation process, especially the scope for using and innovating sustainable energy technology use and their innovation in building.

- From the case study, effective and clear recommendations are proposed to form a guideline for sustainable rehabilitation of Lebanon's built environment.

- To provide advice and guidance for use by built – environment professionals, practitioners and policy makers, for achieving sustainable rehabilitation of the built environment sector.

1.3 Methodology

With respect to the methodology related to analyzing the nature and extent of degradation, an extensive literature review on the interface between built environment rehabilitation and sustainable development will be conducted to determine and acknowledge previous work in the area of study and identify possible gaps in knowledge.

A critical analysis of current urban planning rules and regulations underpinning current urban development will be undertaken. To be able to do this primary and secondary data will be collected and used to analyse the current state of the built environment, particularly the physical environment of Lebanon.

However the coastal area of Zouk Mosbeh will be the focus of our analysis. For the secondary data, government of Lebanon statistical publications, data bank of multilateral and unilateral organisations, United Nations, and World Bank data Bank will be assessed. For primary data, a survey through structured interviews will be carried out. These interviews will be conducted with key players or stakeholders in urban rehabilitation and development to ascertain current perceptions and thoughts on possible future measures for enhancing the environmental sustainability of the coastal town of Zouk Mosbeh of Lebanon. In particular, a questionnaire will be conducted among local residents to determine everyday common problems, with the aim of testing

their awareness of issues related to environmental sustainability in general and urban environmental sustainability in particular. This will help define and evaluate the main problems in Zouk Mosbeh, and form the basis for quantitative analysis, which will be undertaken using statistical package, SPSS10. In addition, qualitative analysis will be used to buttress the quantitative analysis provided.

The null hypothesis will be that unplanned and unregulated developments in the coastal zone of Lebanon contribute to the environmental un-sustainability of the region. The alternative hypothesis will be that unplanned and unregulated development does not contribute to environmental un-sustainability of coastal area in Lebanon. The decision rule is that the null hypothesis will be adopted in favour of the alternative hypothesis if there is overwhelming evidence born out of empirical validation that environmental sustainability in the coastal area of Lebanon is severely undermined by unplanned and unregulated physical development. From the analysis of results there will be policy formulation and prescription as to how and what measures the government of Lebanon and other stakeholders must put in place to facilitate and enhance the sustainable development of the area and the country as a whole.

1.4 Outline of the Thesis

Chapter one is a general introductory chapter, explaining the structure, aims and objectives, and the methodology employed for this thesis. The chapter provides an overview of the physical structure, socio-economic attributes, and political economy of Lebanon, which have influenced the growth and development of the country till the present. In particular, the impact of fifteen years of civil war (1975-1990), and the attendant political instability on growth and development is discussed.

Chapter two provides a critical review of existing literature on sustainable rehabilitation of the built environment in acknowledgement of previous works. It allows the evaluation of the built environment and identifies its impact on the biophysical environment. The concept of Integrated Coastal Zone Management

(ICZM), as an appropriate model for sustainable coastal rehabilitation, is explored. Finally, the tools for the sustainable rehabilitation of the built environment are critically discussed.

Chapter three dwells on urban planning but with more emphasis on building rules and regulations in the context of Lebanon. This takes the shape of a historical overview of the different concepts and schools of thought on urban planning, especially the theoretical underpinning to the various urban planning concepts. Finally, these models were applied to Lebanon.

Chapter four is devoted to the current state of the built environment of the Lebanese Coastal Zone (LCZ). The geographical boundaries of the LCZ are defined. Population growth is looked at for its influence on physical development and growth. Climate is also analysed, emphasising its impact on architectural design of the built environment along the LCZ. Traditional built environment form is then compared to the modern and contemporary, emphasising building types, urban settlement, patterns to reveal the extent to which they comply with the principles of sustainable development. Finally, the analysis presented is used to justify the selection of Zouk Mosbeh, as a case study for this project.

Chapter five is dedicated to the understanding of the physical geography of Zouk Mosbeh (ZM) to which urban growth models are applied. This allows us to understand and appreciate the historical growth dynamics of ZM, especially the implications of such growth for the biophysical environment.

Chapter six describes the theoretical approaches to research methodology in social science. It compares the positivist quantitative approach with the interpretive qualitative approach to research, and finding that there are advantages in combining methodologies and hence the choice of the triangulation approach for this study. The triangulation methodology is critically analysed.

Chapter seven is devoted to the analysis of results from the undertaken empirical analysis. The first part of the chapter analyses the physical data on the characteristics of the three main samples of building types - traditional buildings, low-rise buildings, and medium-rise buildings. Factors considered within these buildings include patterns of water and electric energy consumption, air quality, and noise pollution. The level of poverty of the ZM inhabitants is considered in relation to the wider understanding of the concepts of relative and absolute poverty, given that the ability to engage in post construction maintenance and hence sustainable physical environment may hinge on income levels. This is why data was obtained and analysed on the level of awareness and participatory approach to sustainable development.

Chapter eight starts with conclusions to the thesis and possible recommendations towards achieving sustainable rehabilitation of ZM's built environment. It focuses on the issue of urban planning, legal and other relevant institutional framework. It then identifies, precisely, the roles and responsibilities of the different stakeholders within the area of ZM in ensuring a sustainable built environment, and hopes that these recommendations are applicable to other areas of Lebanon and the wider Middle East and other similar developing countries.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The aim of this literature review is to acknowledge previous work on sustainable rehabilitation of the Built Environment, which is necessary for identifying gaps and contributing to existing knowledge. How much does the built environment impacts on the physical environment? What is sustainable development, and what are the dimensions of sustainability, in relation to the built environment? What is sustainable rehabilitation of the built environment, and how can the built environment be enhanced sustainably through rehabilitation?

2.2 The built environment and its impact on the physical environment

U.S. Environmental Protection Agency (2004) aptly captures the built environment in its various forms and dimensions:

> "The expression built environment recognizes that the physical world in which humans function and thrive has been intentionally created; is something aesthetically and functionally shared; and functions as an organism in the consumption of resources, disposal of wastes, and facilitation of productive enterprise within its bounds. The built environment includes all of the physical structures engineered and built by people, including our homes, workplaces, schools, parks, and transportation systems".

Thus, the built environment embodies complex technological systems that delivers basic human needs, and expected to last over significant lengths of time, involving multiple diverse stakeholders and having technological and ecological impacts on the ecosystem (Pearce, et. al., 2000). That the built environment has a great impact on the natural environment is not in doubt owing to the amount of renewable and non renewable natural resource inputs to construction processes from excavation and production of building materials to the construction and eventual demolition of buildings. During such

processes, huge amount of pollutants and wastes are generated in addition to the huge natural resource consumption. The construction processes also involve the transformation of the physical environment and some of which are irreversible. This is hardly surprising given the assertion that 75% of all known causes of environmental degradation are traceable in one way or another to the built environment (Ebohon, 1997).

Table 2.1

Embodied Energy Content Analysis for Three Building Construction Materials (Emission per Kg product of dry material)

Gas Types	Structural Timber	Roof Truss	Cladding Board
CO2	95.7g	98.4g	94.1g
CO	5.91g	8.33g	5.83g
NOx	3.39g	4.02g	3.34g
SO2	0.112g	0.121g	0.110g

Some selected raw Materials Consumed per Kg Product (dry material)			
Wooden raw material wet/dry	4900/2660 g	5400/2940 g	4830/2750 g
Phosphate fertilizers	0.300 g	0.331 g	0.295 g
Nitrogen fertilizers	1.71 g	1.88 g	1.68 g
Potassium fertilizers	0.300 g	0.331 g	0.295 g
Pesticides	0.0173g	0.0191 g	0.0170 g
Fossil fuels	1.40 MJ	1.38 MJ	1.38 MJ

Renewable energy (Higher Heating Value of Logs, HHVL)			
Renewable energy (HHVL)	54.6 MJ	60.2 MJ	56.5 MJ
Fossil fuels	1.40 MJ	1.38 MJ	1.38 MJ
Electricity	0.0140 MJ	0.0100 MJ	0.00695 MJ

Source: Ebohon 1997.

Table 2.1 gives some indication of the natural resource implications of selected building materials manufacture. In these particular examples, the direct and indirect energy consumption in terms of embodied energy and the amount of energy used in the conversion of these materials are evident. Indeed, Ebohon (1997) argued that such energy consumption intensity compromises the integrity of the physical environment and facilitates environmental degradation. Similarly, Spence and Mulligan (1995) have also argued that the construction

industry together with building materials manufacture impact highly on the natural environment through the conversion of agricultural land, loss of soil, quarrying, mining, and other associated forms of land use transformation. Thus the construction sector exerts enormous pressure on local and global natural resources, and this trend is likely to continue given the persistent and rapidly growing global population and the attendant implications for infrastructure demands, thus, "it is imperative that the attendant demands on global natural resources are balanced with the 'carrying capacity' of the physical environment" (Ebohon and Rwelamila, 2001; p.2).

In Lebanon the impact of the built environment on the physical environment is evident and has reached a crisis proportion (Republic of Lebanon, 1997). This is particularly the case given that over 75 percent of the Lebanese population and economic activity are concentrated in the coastal zone, which is less than 16% of the country's geographical area but contributes about 73 percent of Lebanon's GDP. In addition the Lebanese coastal zone (LCZ) hosts four commercial ports and over 15 fishing harbours, dozens of sea pipelines for petroleum imports, three fuel power plants, and series of various industries. Although endowed with natural landscapes and rich cultural and archaeological heritage, it also remains the main source of the country's drinking water (Republic of Lebanon, CDR, 1997).[1]

However, the LCZ is suffering from uncontrolled urban sprawl and unplanned development exemplified by the beach complexes, citing of landfills, breakwaters, and marinas, which hinder public access to the seashore. Similarly, incompatible coastal land-uses with polluting industries located side by side to residential and commercial developments, especially tourism. The problem is further compounded by unregulated ribbon development along coastal access roads and traffic arteries. However, the problem of environmental degradation in LCZ can also be a symptom of institutional deficiencies, which is more pronounced in the area of planning and regulation. The lack of coastal, regional or national land-use plans; poorly defined national planning authorities; overlapping and uncoordinated environmental

[1] The Lebanese coastal zone is defined and the current state of its environment is analyzed in chapter four

management responsibilities; outdated and inconsistent environmental laws and regulations and lack of implementation of the little regulations that exist are cases in point[2].

Thus, the failure to establish environmental impact assessment (EIA) and the haphazard public participation in decision-making comes as no surprise (Government of Lebanon, CDR, 1997). Lebanon's case is typical of most coastal areas of the developing countries. In most of these countries, coastal areas provide diverse and productive habitats, which are important for human settlements (UN, 1992, Shi et al., 2001). It is hardly surprising that more than half of the world's population lives within 60 km of the shoreline, which is forecast to rise to three-quarters of the global population by the 2020. Coastal zones throughout the world are attractive areas for economic development and opportunities (UN, 1992, Shi et al., 2001). It is estimated that 50 percent of the world's population inhabit coastal zones, which represents approximately 10 percent of the earth's surface (UN, 1992, Shi et al., 2001). Many of the world's poor are crowded in coastal areas (UN, 1992). El Sabh et al. (1998) have robustly argued that this trend of population concentration in coastal areas is expected to continue into the future, and will impose further pressure on the biophysical environment of coastal regions.

Similarly, the environmental pollution impact is huge, including waste disposal from such densely populated coastal areas, the pollutants carried by rivers and released into coastal waters, urban migration, erosion, deforestation, over-grazing, ships' ballast discharges, deforestation, and hydro-electric projects (El Sabh et al., 1998). Coastal resources are vital to many local communities and indigenous people.

Despite national, sub-regional, regional and global efforts, current approaches to the management of marine and coastal resources have not always delivered sustainable coastal development owing to the marked deterioration in the global coastal environment (UN, 1992). It is clear therefore that coastal areas tend to be under pressures from population growth, pollution, habitat

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[2] The critical analysis of urban planning rules and regulations in Lebanon will be further discussed in chapter three

degradation, and over exploitation of natural resources, and due to these conditions there is an urgent need for instituting management measure that will reverse current trends in costal rehabilitation and development. Otherwise, the impact of our built environment on the coastal zone will result in irreversible transformations and degradations, depriving future generations of their rightful heritage. Ngoile and Linden (1998) argue that "Integrated Coastal Zone Management (ICZM) approach has been widely accepted as an effective mechanism for addressing and resolving the multiplicity of issues experienced in marine and coastal areas throughout the world. ICZM programmes provide opportunity for addressing marine and coastal management issues beyond fisheries" (p.307). Such an approach is favourably disposed to sustainable built environment rehabilitation in the coastal zones.

2.3 Integrated Coastal Zone Management and Sustainable Development

The Bruntland Report (WCED, 1987) etched the state of the global environment in the global consciousness of mankind. The report documented the impact of mankind's insatiable quest for economic growth and development on global resources, which is rapidly deteriorating. Although the concept of sustainable development is still debated, the definition provided by Bruntland is the one that will be used as a working definition in this work. This definition is perhaps the most meaningful due to its careful consideration of how needs and limits are interrelated. The Bruntland Report puts it most appropriately when it stated that sustainable development is: "... development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987; p.8).

The limits have roots in technological inadequacies and inequitable social organization, showing concerns for securing global equity, redistributing global resources to poorer nations whilst encouraging economic growth. Sustainable development must therefore entail "a process of change in which exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance current and future potential to meet human needs and aspirations" (WCED, 1987; p.9).

The report highlighted three fundamental components to sustainable development: environmental protection, economic growth, and social equity.

Following WCED, the United Nations Conference on Environment and Development in Rio de Janeiro (UNCED, 1992) tagged the earth summit was convened to address urgent problems of environmental protection and socio-economic development. At this conference more than 100 governments signed a convention on climate change and the convention on biological diversity, recognized the Rio declaration and the forest principles, and adopted Agenda 21. Agenda 21 is a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations, Governments, and Major Groups in every area in which human impacts on the environment (UNCED, 1992). A World Commission on Sustainable Development (CSD) was created in December 1992 which was aimed at ensuring effective follow-up, monitoring and report implementation of the UNCED. In 2002 a World Summit on Sustainable Development (WSSD) was held in Johannesburg, South Africa, to reaffirm the commitment of the different countries to the Rio principles (UN, 2002).

Chapter 17 of Agenda 21 (UNCED, 1992) entitled "Protection of the Oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources", considers the marine environment as an integrated whole and an essential component of the global life-support system. This requires new approaches to marine and coastal area management and development, at the national, sub-regional, regional and global levels, approaches that are integrated in content and are precautionary and anticipatory in ambit (UNCED, 1992). Global awareness should accordingly move from an adhoc to a comprehensive and integrated approach. This requires a move from the protection of marine environment and coastal resources to the concept of sustainable development (El-Sabh et al., 1998).

Clarck (1994) identifies a number of benefits of implementing ICZM programs, including:

- Facilitating sustainable economic growth based on natural resources;

- Conserving natural habitats and species as well as rehabilitating degraded resources;

- Controlling pollution, alteration of shore lands by excavations, mining, poor land use practices etc.;

- Providing mechanisms and tools for rational resource allocation and minimizing user conflicts.

However, there are some necessary prerequisites to successful ICZM program of which the most important factors are political commitment, awareness, and collaboration with stakeholders (Clarck, 1994). Masalu (2003) tackles an important issue with regards to the successful implementation of ICZM, which is the problem of poverty that is characteristic of many developing countries, requiring these countries to improve their economies. Most of these countries are adopting economic liberalization policies under the guidance of the World Bank and the International Monetary Found (IMF). The outward looking trade liberalizing policies prescribed for these countries have become a major source of conflicts over access and use of resources. In his paper Masalu (2003) conducted a case study of Tanzania to convey the conflicts between the local government and the local communities, environmentalists, and social activists, caused by prawn farming project. According to the government the project should bring high economic benefits in form of jobs and improved export earnings to the people in contrast to the beliefs by environmentalists and social activists who considered the benefits associated with the project to be far less than the likely environmental degradation.

Following this crisis, the Tanzania Coastal Management Partnership started formulating a national policy for Integrated Coastal Area Management (ICAM). The ICAM policies integrate all other regional policies which address issues relevant to coastal area and resources management. The conclusion is that

specific environmental policy instruments such as the Environmental Impact Assessment (EIA) process, reviews of EIA, public participation and awareness, and effective ICAM policy should be backed by strong political will and commitment to delivering a healthy environment on the part of decision makers. This must also be backed up by transparency and fairness on the part of investors (Masalu, 2003).

The World Bank (1993) and the United Nations Environmental Programme UNEP (1995), set series of steps considered to be essential in developing ICZM plans among which the preparation of detailed information about the physical environment, coastal processes and ecosystems, and cultural features. This must be accompanied by the geographical scope of the plan; the establishment of mechanisms to ensure participation in the process; assessing past and present management and their impacts on the existing landscape, and analysing the feasibility and desirability of new development. Similarly, the establishment of legal structures and necessary institutional, legal and administrative framework for ICZM; setting clear objectives and priorities; drawing up the initial plan and proposed projects, including proposed regulatory measures and enforcement system most be considered. Also, economic incentives to ensure wise use of resources; building up EIA of the proposed plan or projects; consider public comment on the proposals, and revision of the proposal; implementation of the plan; monitoring and evaluation of the outcome; review and revision of the plans, as results become available, must be achieved for successful implementation of ICZM.

ICZM plans must also promote socially and economically sustainable livelihoods for the local population, which is necessary for the long-term maintenance of the coastal-areas (World Bank, 1993, UNEP, 1995). Thus, an integrated coastal zone management ICZM aims at putting into practice sustainable development and the conservation of coastal zones, maintaining their bio-diversity, and improving their physical status. It combines the physical, biological and human elements into a single management framework. For it to succeed there must be a political commitment to integrated coastal management awareness, and collaboration. In addition, and depending on the

different cases, an environmental impact assessment or a strategic environmental assessment should appropriately be conducted to identify the form of proposed activities. Finally public awareness and participation is a mechanism that should appropriately be established. ICZM is necessary and must be part of the national territorial planning of Lebanon because of the enormous physical environmental problems associated with rapid urban development along its coastline. Integrated Coastal Zone Management is expected to stem the rapidly unfolding deterioration and degradation of the coastal zone and thereby enhance the sustainable rehabilitation of the built environment of the area.

2.4 Sustainable Rehabilitation of the Built Environment:

Pearce et al. (2002) considers rehabilitation as a route to sustainable built environment. It is argued that as the costs of new construction is increasing; attention would have to be paid to the rehabilitation of existing structures as a cost-effective and otherwise attractive strategy for meeting human needs for built facilities (Pearce et al., 2002). Fielden (1994) states that the best way of preserving buildings as opposed to objects is to keep them in use – a practice which may involve what the French call 'mise en valeur', or modernization with or without adaptive alteration. The implication is that rehabilitation has social, cultural and economic advantages. Social, in that people and towns keep their identity; cultural, in that artistic, architectural, archaeological and documentary values can be preserved both for their intrinsic value and their contribution to the identity of the town; economic in that existing capital is used, energy is saved, demolition costs are avoided, and minimum pressure exacted on existing infrastructures of roads and services. Rehabilitation induces less human upheaval, political friction and physical delay; it is therefore not surprising that when the total budget is considered, rehabilitation in most cases saves money (Fielden, 1994).

Rehabilitation is seen as the process of returning components of the built environment to a state of functionality through repair or alteration. This process makes possible efficient contemporary use while preserving, where appropriate, the features that are significant to their historical, cultural and

architectural values. Fahmi (2000) considers rehabilitation as inducing "fewer changes to the built environment form, but more changes to social and economic fabric of local people in order to make old cities appealing and significant to its population..."(p.6).

Pearce et al. (2002) argue that rehabilitation of existing structures should be a central strategy for creating a sustainable environment that meets human needs while maintaining the natural environment in a healthy and useful state, and that whether by repairing damaged facilities or renovating them to serve new purposes, rehabilitating existing structures is a practice which contributes to sustainability by reusing existing materials and avoiding much of the energy consumption used for new construction and saving energy embodied in new materials. Additionally, the traditional criteria of cost, time delay and quality, accommodating human needs and aspirations (food, water, social contacts, economic activities, building construction industry), is minimized through rehabilitation, thus, avoiding the negative environmental impacts of displacement, over-harvesting of natural resources from ecosystems, and waste generation. Generally, rehabilitated projects provide many advantages, including maintenance of historical and architectural integrity, revitalizing urban areas, and avoiding negative environmental impacts and unnecessary consumption of materials and energy (Pearce et al., 2002). Thus, "in planning a sustainable rehabilitation project, it is necessary to consider the surrounding context of the project, potential impacts on the human and natural environment, and economic viability compared to other alternatives" (p.5).

Pearce et al. (2000) present a guide by which sustainability can be incorporated in to the construction industry to create a new kind of built environment form. The guide provides decision-makers with indicators for ensuring sustainability of built facilities, identifying key strategic points, and providing an overview of considerations for sustainability in terms of the life cycle of built facilities. Built facilities are defined as complex technological systems that meet critical human needs, persisting over significant length of time, and involve multiple diverse stakeholders (Pearce et al., 2002). This is expected to have significant impact on both the technological and ecological

systems. Thus, five starting points for defining global sustainability policies have been identified (Pearce et al. (2002) :

- internal and external contextual compatibility,

- environmental benign-ness,

- long-term sustainability,

- enhanced life cycle product and process performance,

- planned end-of-service-life transition".

Furthermore, eight components as strategic objectives and measurable goals in terms of sustainability principles have been suggested (Pearce et al., 2002). The first two define the entire project and set the stage for all project decisions, establishing strategic objectives, measurable goals, and execution of plans for project sustainability. The next four components define structured framework of considerations that guide the complete delivery of the project. The final two components involve active consideration of sustainability principles by involved stakeholders with the use and end-of-service-life of the facility (Pearce, et al., 2000).

Nevertheless, orientating a sector like the built environment of the economy towards environmental sustainability is an onerous challenge. This very issue of business orientation was tackled by Loots (2000) who compares the traditional route of business development with the re-direction of business towards sustainability. He discusses the difficulties that arise in any decision to change from one approach to another due to inevitable risks, and uncertainties. Loots (2000) posed many important questions in relation to the role of the construction industry in sustainability due to the impact of the built-environment on the economy, the ecological and communal development. He then illustrates where strategies are most helpful in this re-direction process, and

then discusses these diverse contributing factors considering the real current state and the various causes contributing to the current situation, the idealities which are the results of sustainable business decisions, and the strategies to bridge the gap between realities. Loots (2000) conclude by giving suggestions especially for the architectural professions:

- The type of buildings that are frequently designed and repeated should be re-evaluated.

- Theory should actively inform practice and vice-versa.

- The public should be re-educated regarding the Architect's role and should question their contribution and accountability.

- Impact assessments of new, existing and destructed buildings or developments are useful tools to consider the implementation of environmental parameters.

- A vehicle or body should be created which could inform the architect of 'sustainability' tools available to inform the creative process and measure the sustainable performance of a building.

- Architects and consultants to the construction industry should be informed of all the aspects that involve the completion of the life cycle of a building (Loots J., 2000).

Spence and Mulligan (1995) show that improving technologies and changes in the design practice will help in reducing negative impacts on the environment and its deterioration, by improving land-use, reducing pollution emission, preconstruction of environmental impact assessments, by rehabilitating and maintaining existing buildings, recycling by reusing the mineral, agricultural, and demolition waste in construction. They also suggest ways for governments to take action to promote change, by introducing new and

appropriate legislation, and controls, economic incentives, and non-regulatory activities (Spence and Mulligan, 1995). According to Ebohon and Rwelamila (2001), construction industry sustainability is a dominant feature in analyzing sustainability. They argue that the construction sector, relative to its level of development is more than sixty percent of gross capital formation in most of the countries, defining the physical infrastructure to achieve effective growth and development, and that the construction sector exerts enormous pressure on local and global natural resources creating a situation of rapid depletion rate in global natural resources and at the same time that the global population is rising. It is therefore imperative that the attendant demands on global natural resources are balanced with the 'carrying capacity' of the physical environment (Ebohon and Rwelamila, 2001).

Thus, sustainable construction is considered a direct response to the continuing rise in global consumption and the attendant deterioration in the global physical and biotic environment. This concept of sustainable construction now transcends environmental sustainability, embracing economic and social sustainability (Ebohon and Rwelamila, 2001; p.2). Du Plessis (2002) tackles the issue of social and environmental responsibility in relation to the negative impact of the construction sector. The construction sector being a significant user of resources, and polluter and should not therefore escape the call of accountability and responsibility, she states: "In Southern Africa there is a saying that a person is not human without other people. When applied, this principle of "ubuntu" means that the individual has a responsibility to take care of the welfare of society, and that society in turn has a responsibility to take care of the welfare of the individual. This is social responsibility in its purest form" (Du Plessis, 2002).

Indeed, Du Plessis informs that the international community is increasing regulatory pressure on the construction sector to be socially and environmentally responsible in order that business practices aligns with the principles of sustainable development (Du Plessis, 2002).

Du Plessis (2002) considers sustainability "the condition or state which would allow the continued existence of Homo sapiens, and it is the goal we would like to achieve. However, survival alone is not enough; we also want a certain quality of life that meets our full hierarchy of needs" she adds that to achieve this state, the relationship of human being with the biophysical environment and their socio-economic relationships will have to meet certain requirements. "Firstly we need to balance the needs of humans with the carrying capacity of the planet, and with the need to protect that capacity so that the needs of future generations can continue to be met. We also need to achieve a measure of social and economic equity between individuals, as well as between communities, nations and generations".

Du Plessis (2002) defines "sustainable human settlements", cities, towns, villages and their communities, living and supporting the state of sustainability and the principles of sustainable development. "Urban sustainability is the broader process of creating sustainable human settlements, especially towns and cities. It includes sustainable construction, but also the creation of institutional, social and economic systems that support sustainable development". Thus, sustainable construction means that the principles of sustainable development are applied to the comprehensive construction cycle from the extraction and beneficiation of raw materials, through the planning, design and construction of buildings and infrastructure, until their final deconstruction and management of the resultant waste" (Du Plessis, 2002)

From these considerations, it is clear that the rehabilitation of existing structures is a priority in the planning of the built environment with respect to new building construction in terms of the various aspects of sustainable development. Rehabilitation of the built environment has many advantages in revitalizing cities, including the conservation of historical buildings and the maintenance of architectural integrity, and in avoiding negative environmental impacts through the unnecessary consumption of materials energy and waste disposal. In planning a sustainable rehabilitation project, it is necessary to consider the surrounding context of the project, potential impacts on the human and opportunity cost.

2.5 Conclusion

In this chapter the interface between the built environment and the natural environment has been analyzed. Special attention was devoted to coastal areas as the focus of this research. The particular pressures of population growth, pollution, habitat degradation and over-exploitation in coastal areas were discussed. Integrated Coastal Zone Management (ICZM) approach has proven to be a comprehensive, holistic and effective preventive mechanism of addressing coastal zone environmental degradation and achieving the objectives of sustainable development. The case for sustainable rehabilitation was finally analyzed in contrast to new development to show how much rehabilitation can enhance the sustainability of the built environment.

Sustainable rehabilitation of the built environment allows construction materials to be recycled, agricultural land and natural habitat maintained, forests and wild land preserved, and waste production minimized. Thus, buildings can be conserved, reused, restored, and renewed in manners that satisfy the needs of the present generation without compromising the needs of future generations.

For environmental sustainability of the coastal area to be realized, a serious commitment is required from the government and other stakeholders. This requires the government to incorporate the concept of environmental sustainability as part of its political agenda and have strategies by which local participation is encouraged. Sustainable development requires such strong political commitment to avoid becoming rhetoric devoid of meaning and actions.

The challenge is how to achieve sustainable rehabilitation of the built environment in Lebanon, a country member of Agenda 21, a country that has suffered fifteen years of war, before which it did not follow any effective physical urban planning with huge environmental, social and economical implication.

How sustainability can be achieved in the particular context of Lebanon given the political instability and regional tensions together with inadequate institutions remains the challenge and focus of the rest of the thesis.

CHAPTER 3

CRITICAL ANALYSIS OF URBAN PLANNING RULES AND REGULATIONS IN LEBANON

3.1 Introduction

The evolution of 'Modern' urban planning in America and Europe is briefly reviewed in this chapter to contextualise our analysis. The impact of the French mandate 'Modern' approach, to urban planning through history in Lebanon is then critically analysed. The effect of the fifteen year (1975-1990) civil war on urban development is also critically studied. The chapter concludes with a brief summary of the current institutional framework governing regional planning and a critical assessment of the latest 'National Physical Master Plan of Lebanon' (LNMP) developed between 2002 and 2004. The assessment of the LNMP will look at whether sustainable principles of urban development have been included in the project.

3.2 Evolution of Urban Planning in Modern Times

Hardoy (2001) argues that "city" and "urban" are often used interchangeably, and that there is no consensus on their definitions. Most governments define urban settlements based on one or a combination of any of the following criteria: including population size, population density, and social and economic factors, such as the proportion of the labour force engaged in non agricultural activities; the administrative or political status of a locality, such as national, provincial, or district capitals; or census designations (Hardoy et al. 2001). Besteliu and Doevendans (2002) state that "the city is the greatest spiritual creation of humanity; a collective work which develops the expression of culture, society and the individual in time and space" (p.1). March (1910) defined "City Planning" "the orderly development of a city by which each section is arranged for the purpose for which it is best and most economically adapted, so that a harmonious entity is secured. Development must be for the common good and not for the individual's gain" (March 1910; p.73). From these definitions, it can be argued that urban planning is about improving life in

cities by making the most rational use of land, while maintaining a harmonious relationship with the physical environment.

Around the end of the nineteen century, the impact of the demographic and economic growth - the world population growth, the migration from rural towns to cities, the industrial development and the development of the physical infrastructures such as roads, railways, canals necessary to back the new economic situation – gradually put pressure on rural and urban areas in Europe and America. This resulted in poor quality of light, ventilation, open space, sanitary facilities, drainage, open sewerage, refuse disposal, flooding, and inadequate maintenance. In response to this situation early legislation was enacted in the United Kingdom and other parts of Europe. Movements aimed at providing people and factory workers, with healthier environments, were behind the generation of the concept of 'garden city'. Defined as the Utopians, Owen, Morris, Fourrier, Godin, and Cabet, developed utopian communities some of which were built, such as Letchworth and Welwyn in the United Kingdom (Benevolo 1971, Tafuri 1976, Frampton 1992). These cities were to be self-sufficient, small in size, and could be inhabited by a limited number of people. In Paris in 1853 under the rule of Napoleon III, Haussmann put forward a radical plan based on the idea of extensive linear demolition (*percement*) to create entirely new streets. Similarly, in the beginnings of the twentieth century Tony Garnier reiterated the concept of self-sufficient city, with his 'Cité Industriel' or industrial city, and Le Corbusier's 'Esprit Nouveau' and the 'Immeuble Villa' project (Benevolo 1971, Tafuri 1976, Frampton 1992).

It is clear from the literature that before the Second World War; urbanistic thinking did not follow the same lines of development in America as in Europe. Indeed Tafuri (1976) argues that "Whereas American urbanistic thinking developed along essentially unified lines, in Europe the processes were multiple and extremely diversified, and this is because neither industrialization nor modern forms of state organization were arrived in all countries at the same rate" (p.43).

Choay (1965) opposes two broad theoretical models that formed the basis of 'Modern' Urbanism from the nineteenth century to the Second World War. She considers that the two models, namely 'Culturalist Urbanism'[3] and 'Progressivist Urbanism'[4], to be respectively directed according to two fundamental directions of time, the past and the future, or nostalgia and progressivism (Choay, 1965).

MacLeod (1996) considers the negative impacts of 'Modern' Planning on the city and argues the need for the post modernist approach to planning to seek ways to improve planning. He criticizes, 'tabula rasa', or the demolition of entire area for new developments. This modernist approach to planning and development only serve the interests of capitalists and developers allowing only the elitist group to participate. This is usually where decision is taken from the top where development is bureaucratically dictated. Tafuri (1976) considers that 'Modern' master planning and zoning as "means of control of urban land use reflect the economic interests of the forces that urge its adaptation. Zoning is always, in fact, a merely restrictive regulation designed to limit the most harmful consequences of unbridled real estate speculation, but not to eliminate the causes" (p.42). In contrast 'Post modernist' urban development considers planning from a small-scale perspective, with its sensitivity to local interests, context, and human scale, including therefore a wider range of interests. Thus, MacLeod (1996) argues that post-modern planning "is concerned with community and city building, regeneration, and renewal". The indicators of

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[3] Culturalist urbanism, whose main followers include William Morris (1834-1896) English writer, painter, and poet, and Camillo Sitte (1843-1903) Austrian, architect, city planner, theorist, and painter. According this approach, the city is a cultural whole and its aim is to serve the citizen. It also considers that urbanism should build up an existential environment for the development of the spiritual needs of the group, and organized around community dwellings. Their tools are history, archaeology, and poesy (Choay, 1965).

[4] Progressivist urbanism, whose main followers include Jean-Baptiste Fourier (1768-1830) a French mathematician and physician, Robert Owen (1771-1858) English planner and theorist, and later Le Corbusier (1887-1965) a Suisse-French Architect, with a universal approach. Their ambitious aim was to improve human being and science was seen as the basis for individual well being. Progressist urbanism is anchored by the Functionalism model where dwelling is the centre core, and that modernity requires a rupture with the historical city. In agreement with Choay (1965), Beauregard (1989) argues that the early modernist planners held utopian attitudes and belief in a future in which social problems could be tamed and humanity liberated from the constraints of scarcity and greed (Choay, 1965) .

appropriate planning regime ascribed by MacLeod (1996) include sensitivity, inclusiveness, community building and small-scale orientation.

In his paper Hourihan (2000) reviews four books on planning, two from North America and two from Europe, representing different perspectives on planning and different time periods and different types of communities (homogeneous and heterogeneous) . Hourihan (2000) argues that the problem of planning occurs in heterogeneous cities where the issue of equity and discrimination becomes very important to consider. From this brief history of urban planning and urban design we can consider that what urban planners and urban designers seek to achieve from planning and design is the aesthetic quality, and the efficiency of cities, as defined by their functionality. However, this may produce homogeneous cities where there are no cultural, economic (poverty), religious or racial differences, and this is a mark contrast to heterogeneous cities.

It is important to consider also the differences between the developed countries and developing countries concerning the evolution of urban planning. The developed countries followed, as it can be seen from its history, different stages of evolution, experience and maturity, in urban planning, while in developing countries no real evolution or urban development pattern was possible due to colonialism. The latter applied their own experiences disregarding the peculiarities of local culture, and cultural values, resulting in the present situation of urban planning in Lebanon. Somma (2000) considers that under the mandate period urban planning was used to establish and maintain its extractive systems. The French in conjunction with local elitists adopted physical segregation in their urban planning to achieve their own goals. The urban hierarchy was based on trade related settlements (Somma, 2000).

The third section of this chapter will show the historic development of urban planning in Lebanon to the present day, and how much it was influenced by the French modernists. In order to understand what the purpose of planning is, it is appropriate to begin with the question: why should we plan?

3.3 Theoretical underpinning to Urban Planning

Yoshitsugu (1980) considers "cities concentrations of people and the essence of urban life is the presence, for better or for worse, of many other people". "...no man is an island, entire of it; every man is a piece of the continent, a part of the main..." In this meditation John Done (1572-1631) affirms the interdependence of man by implying that no one man can exist on his own. Furthermore, Thomas More in "Utopia", edited by Logan et al. (2002), describes an island nation that thrives in its isolation to develop the concept of an ideal society. In this book, the authors suggested that the success of such an island can be pinned down to interdependence between nature and man. The concept of 'liveability' presupposes a special relationship between human beings and their biophysical environment. People need to settle in a place that becomes a part of their lives and provides opportunities for contacts and social exchanges. Inhabiting a district must be considered under the meaningful aspects of identification, which concerns the quality of things and orientation in relation to their spatial relations. In this regard, identification becomes the sense of integration in the inhabited environment and in all that is expressed by physical structures in their contextual environments. This is most important, since the unifying role of the environment and the consequent identity, is inter-dependent in what is traditionally regarded as 'genius loci' or the spirit of the place (Shultz, 1979, 1985).

Furthermore, Shultz, (1979), introduces the concept of "liveability" that defines a special relationship between man and nature underpinned by a community. A Community is a broad and fluid concept whose definition has been debated among social researchers with some defining it in relation to a geographical area; some to a group of people living in a particular place, while others see community as being an area of common life. Generally, a community could be defined as a group of people gathered in a certain geographic area sharing common interests and common sense of belonging to the area. Such a geographic area could be a shelter, a building, a neighbourhood, a town, a city, or a country, (Rovai, 2002).

Similarly, a community could also relate to religious groups of people, or people sharing common political affiliations, or sport clubs, etc. Homogeneous members (people living in modern new towns) sharing common socio-cultural interests and values or heterogeneous members with the same material interests could compose a community. Hugues (2000) refers to Ferdinand Tonnnies (1925) to present the social science view of community and society or association. Tonnies (1925) considers community as an entity, which exists "by the subjective will of its members: the very existence rests in the consciousness of belonging together and the affirmation of the condition of mutual dependence".

Shultz (1979, 1985) considers that buildings must grow up together with their inhabitants. This indicates that buildings must not only evolve, but evolve with the community so as to mature within the biophysical environment. The implication is that any subsequent addition must not differ, at least, significantly from the urban history and geography of the area. This historical phenomenon of urban growth underpinned by community is known as gradual growth where each element is part of an organic whole. In this regard, a town is an organism that evolves steadily and continuously in pace with its inhabitants and their traditions. In contrast to the concept of community, Tonnies (1925) considers "gesellshaft" or society or association as "the objective fact of a unity based on common traits and activities and other external phenomena". Bellah et al. (1985) as stated in Rovai (2002) define community as "a group of people who are socially interdependent, who participate together in discussion and decision-making, and who share certain practices that both define community and are nurtured by it". However, interactions of these kinds between people may generate externalities, which could be beneficial to some within the community but not to others (Mitcham, 1995).

This appears to suggest that the essence of urban planning is the result of huge externalities that derive from socio-economic activities, especially in the built environment. Traffic congestion, discrimination, pollution, and public services, all involve externalities, and are all important matters of public policy. Yoshitsugu (1980) states that externality is not unique to the built environment,

but it occurs when there are transactions between two parties and when an agent does not compensate others for the effect of his or her actions. According to Mitcham (1995) an important characteristic of externalities is that there is no deliberate intent to harm.

As both Langston and Ding (2001) note, Perkins (1994) states that "when the existence and operation of a project result in a net gain or loss to society but not those who undertake the project, then this category of benefit or cost is defined as an external effect or externality" (p.88). An interesting example is given by McTaggart et al. (1999) "If I decide to burn down my neighbour's house there is no externality, but if sparks from my barbecue, set it alight then there is. Upon this definition, it does not matter for this definition whether, when I lit the barbecue, I was aware of the fire risk or whether my action was negligent. As long as my intention was not to cause a fire and no laws were broken, we have an externality. Similarly, when a factory or sewage treatment plant legally disposes effluent into a stream, it probably does not take into account the costs that this action causes on members of a fishing club who like to fish lower down in the stream". According to Langston and Ding (2001), externalities can also have a positive effect that is beneficial to the greater community; they give as an example here the hospitality or tourist industry.

To internalize negative externality policies and incentives that are sufficient enough to cause a change in behavioural patterns will have to be provided by governmental bodies. Externalities can be positive when the action of one agent raises the welfare of another. It is important to conclude that it requires conscious planning to maximize positive externalities and minimize negative ones (Bowers, and Young, 2000). It is therefore possible to suggest that a participatory development planning process offers huge potentials for mitigating and internalizing possible externalities.

3.4 Urban planning in Lebanon from 1932 to 1990

Arguably, the evolution of urban planning in Lebanon started in 1932, when the first master plan for Beirut was proposed under the French mandate (1922-1946). In this pre-independence era serious attempt to prepare master plans

for Beirut was undertaken by the French. The earliest master plan was designed by the French consultant Paul Danger in 1932 (Republic of Lebanon 1997, Salam 1998). According to Salam (1998), it was the first attempt at a comprehensive study of the capital, taking geographic, climatic, geological, and human factors into consideration. The Danger project (1930) proposed three major axes of circulation (Beirut - Saida, Beirut - Tripoli, Beirut – Damascus), zoning, densities, open spaces, and land use to be built according to the schemes of the "Garden City". Danger's plan included also a building and sanitary code that aimed at regulating the buildings' aesthetic and at regulating public hygiene. The plan was inspired by the French sanitary law of 1902, but not adapted to the local geo-climatic conditions. However the plan was not approved by the government and was never implemented (Republic of Lebanon, 1997, Salam, 1998, Somma, 2000).

In 1944 a French architect Michel Ecochard, former head of Urbanistic services in Syria, proposed an extremely detailed plan for Beirut; his plan considered the planning of Beirut beyond its metropolitan and administrative boundaries incorporating the suburbs (Nahr el Maout to Ouzai), with segregation of land-uses through zoning (industrial location, housing for workers, popular housing, civic centres, etc.). In all, 12 land-use zones where defined. Somma (2000) considers Ecochard a 'passionate' follower of the principles of the Athens Charter [5], and the main priority set for the plan, with respect to previsions, was the creation of a traffic vehicular system. In comparison to Danger's plan, Ecochard's plan was not limited to the development of a report and related drawings because he was aware that such limitations would lead to non-implementation. Therefore, he added financial and legal elements to the report. Ecochard did use the same circulation and traffic development of the Danger's

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[5] In architecture the Athens Charter (or 'Charte d'Athènes') was the result of the 1933 Congrès International d'Architecture Moderne. CIAM laid out a program for planning and construction of 'rational cities', addressing topics such as high-rise residential blocks, strict zoning, the separation of residential areas and transportation arteries, and the preservation of historic districts and buildings. "The essence of city planning was to provide a functional framework for the society in reference to accommodation, work and recreation, taking care of land-use, traffic, and the legal framework" (UNESCO, 2003, p. 106).

plan, and zoning criteria, when he divided the city into twelve sectors (Somma 2000).

Indeed, Danger's plan was never approved nor adopted by the government. Somma (2000) argues that Ecochard's plan giving the government and the municipality urban development decision making power, and recommending, the creation of an Urbanism body, was in contradiction with both the French mandate's liberal-capitalistic political approaches and the expectations of local political elites. These constraints were coupled with the rejection of any limitation to construction activity or land use. Due to this situation Ecochard manifested his annoyance through articles in the media and relocated abroad. Both Danger and Ecochard have nevertheless influenced all the following urban plans and choices and many of the basic concepts were preserved and introduced in later plans. In 1950 another French Architect, Egli, proposed a master plan, this was mainly a re-appraisal of Ecochard previous plan, and reduced the number of zones to five. This plan too was never approved by the government (Republic of Lebanon 1997, Salam 1998, Somma 2000).

Between 1952 and 1954, a master plan, *'Plan Directeur'*, for Beirut was proposed by a commission of experts that was appointed by the municipality of Beirut, and was partially approved by the local authorities. The plan included only the traffic roads network as previously designed by Danger and Ecochard excluding any additional requirements. This plan did not incorporate a zoning program, and did not consider the economic and social problems of the city of Beirut. This plan put emphasis on major roads, with no attempt at preserving natural sites and monuments or planning for future urban growth. The rest of the country was controlled by the obsolete building code dated to 1953, which was superficially amended in 1954 (Republic of Lebanon 1997, Salam 1998, Somma 2000). Salam (1998) describes the political and administrative situation of this period, as based mainly on allegiance and loyalty to the mandatory power.

Furthermore, this code was largely without any framework or structure that set out guidelines or powers of control and inspection. An unlimited number of

amendments to the building code in the form of decrees of law were introduced. But these were insufficient, in that they were contradictory in some cases. At any rate, it seems that the amendments aimed at eliminating any building restriction whatsoever in order to allow a maximum use of the built-up areas (El Achkar 1998). The 1954 master plan did not take any measure concerning environmental protection, nor any form of coordination between adjacent municipalities. This 'Laissez-faire' approach lead to saturation or overbuilding, chaotic peripheral urban spread, and high densification. This chaotic situation persists to the present and has resulted in high levels of congestion, and environmental degradation (Republic of Lebanon 1997, El Achkar 1998, Salam 1998).

The period between 1958 and 1964, is well known in Lebanon as the period of Shehabist reforms, because of the first serious administrative reform attempted in Lebanon. Spatial planning at the national scale was introduced by president Shehab's administration to address problems of regional disparities and social inequities. This administration attempted for the first time to revitalize the countryside and curb urban rural migration. In 1960 the Executive Board of Major Projects for the city of Beirut was created. In 1961 a French mission IRFED, published its report "Besoins et Possibilitiés de Developement au Liban" (Needs and Development Possibilities in Lebanon). The aim of this mission was to assist the Ministry of Planning in setting the basis for a five-year master plan.

In his proposal Father Lebret, director of IRFED, aimed at establishing a balanced regional development that would create harmony between agriculture and industry in the various regions of Lebanon (Verdeil, 2003). A first national survey of urban and rural settlements was developed, and an assessment study of development needs at national and regional levels was conducted. This allowed the development of a comparative regional development index. Verdeil (2003) argues that these innovations in planning were not fully accepted or understood by some Lebanese experts, and the Lebanese administration was not ready to implement IRFED's proposed plan. Another

original approach to planning proposed by Lebret was the organization of a public promotion campaign to inform the public about the plan.

Furthermore, Verdeil (2003) considers that Lebret aimed at gaining public support to counteract the strong resistance of the elitist groups and businessmen opposing president Chehab's regime. As soon as president Chehab's mandate was over, the plan proposed by IRFED was replaced by other plans. This very close dependence of planning on a specific political agenda rejected by many politicians jeopardized the implementation of the plan as soon as the power shifted from one political group to the other (Verdeil, 2003).

Thus, the first town planning legislation for Lebanon was approved in 1962, and in 1963 the Directorate General of Urbanism (DGU) was created together with the Higher Council for Urban Planning (HCUP). The HCUP included representatives of the different ministries; however, its responsibilities were limited only to give recommendations, it had no decision power, and to assist the Green Plan project; the decision was reserved to the Government and to the President of the Republic, who continuously amended and modified zoning prescription and land use (Republic of Lebanon 1997, Salam 1998, Somma 2000). They also removed the few regulations regarding protection of the natural heritage, as it was considered to block economic development (Somma, 2000). This period was considered the most economically prosperous for Lebanon, and it is argued that the investments were mainly directed towards infrastructures and building development disregarding industrial and agriculture sectors (Republic of Lebanon 1997, Salam 1998, Somma 2000).

A commission appointed and assisted by Ecochard, upon his return in 1963, whose urban theories were in perfect harmony with President Shehab's priorities according to Somma (2000), prepared and submitted an official Greater Beirut (Beirut and its outskirts) Master Plan (commonly referred to as "the plan Ecochard"). This plan was partially approved. Verdeil (2003) argues that Ecochard knew Lebanon very well, its Government, its politics and its

technical experts. He "sought a kind of compromise in getting some of his ideas accepted, in order to leave a strong imprint on Lebanese planning" (p.19). He also took into consideration the expectations of landowners. The plan consisted of functional zoning (industrial zones and public utilities) controlling suburban densities, and freezing coastal development (*non aedificandi*).

However, Somma (2000) described this new plan as a copy of the plan proposed previously in 1944. The difference is in the fact that indications covered a larger territorial area with few suggestions regarding environmental protection. Furthermore, Somma (2000) summarizes the main objective of the plan as to give a modest order to the rapid urban expansion, aiming at building a "healthy city next to an unhealthy one" (p.101). Nevertheless, this plan which guaranteed prosperity to the construction sectors was partially approved (Republic of Lebanon 1997, Salam 1972, Salam 1998, Fawaz, 1993, Somma 2000). Verdeil (2003) considers that although Ecochard's 1963' plan was amended in the final approval process, some of its main guidelines still rule today's planning regulations, and in a particular way those related to the road network and zoning ordinances.

Between 1963 and 1975 master plan studies for Beirut and a number of rural and urban settlements were conducted. In 1964 an amendment to the building code allowed the addition of a further floor on the roof of existing buildings. In 1970 a rule concerning all operations to be undertaken on important sites was developed. This rule was known with the term of 'grand ensemble', and abolished buildings' height limits or number of floors provided that projects would be approved by the HCUP. In 1971 a law (L'Encouragement à l'amélioration foncière) encouraging real estate improvement, increased land use ratios and, abolished the 1959 law regarding the protection of the coasts due to pressures by parliamentary and landowners (Somma, 2000).

In 1973 the "Livre Blanc" was published. This document forecasts the future of urban growth and policies for decentralization. The Ministry of Housing was then created. 1975 saw the beginning of the war, and between 1976 and 1977

the Ministry of Planning was dissolved and the Council for Development and Reconstruction (CDR) was created. The first reconstruction plan for Beirut was designed by a French consultant company l'Atelier Parisien d'Urbanisme (APU). The 1962 town planning legislation and expropriation law were amended. During the civil-war (1975-1990) the entire situation deteriorated due to a lack of respect for building rules and regulations. In addition new regulations further decreased the limits to building activity. In 1980 a law increasing the built-up volume of buildings along the Lebanese territory was introduced. This allowed adding one floor to all existing buildings, tagged as "The El Murr floor" following the family name of that year's Minister of housing Michel El Murr. El Murr, considered transferring the taxes paid, as a compensation for the people who suffered during the civil-war and Israeli invasions (Somma, 2000)

A new town planning legislation was introduced in 1983. Between 1983 and 1986 a Franco-Lebanese team of experts "*Institut d'amenagement Urbain pour l'Ile de France*" (IAURIF) formulated a Master Plan for Beirut "*Schema Directeur d'Aménagement de la Region de Beirut*". The plan integrated all previous plans of reconstruction and rehabilitation with the main objectives of recentralization for unification and restructuring for orderly urban growth and development. From 1987 to 1993, the reconstruction of Beirut Central District (BCD) was the main work undertaken, in addition to other housing projects in the outskirts of Beirut to replace the existing degraded urban fabric (Republic of Lebanon 1997, Salam 1972, Salam 1998, Fawaz, 1993). The newly introduced regulations to the already existing ones have theoretically increased the number of penalties. In reaction to widespread violations of building rules and regulations, and to counteract the reluctance of some Municipalities and Governmental authorities to enforce and implement existing rules and regulations, significant number of new rules and regulations were introduced (Somma 2000).

In March 2002 the Government of Lebanon, represented by the Council of Development and Reconstruction (CDR) started a project aiming at developing a comprehensive National Master Plan for all Lebanon. For this project, CDR

appointed the French commission IAURIF and the Lebanese private consulting firm Dar el Handassah for the development of this plan. It was to be undertaken through the collaboration with the CDR, the General Directorate of Urbanism, and both ministries of Public Works and of the Environment (Republic of Lebanon, 2004, b). The development of a comprehensive urban plan for development in Lebanon was on the political agenda of former President Chehab and among the recommendations of the IRFED French group back in 1961 (Verdeil, 2003, Harb, 2003). This plan is further discussed and critically assessed in the next section for its importance in the future urban development in Lebanon, and to highlight possible gaps in relation to sustainable urban development in Lebanon.

3.5 Urban Planning Framework and Latest Master Plan

Table 3.1 summarizes land management in Lebanon and clearly indicates that it is the responsibility of the Director General of Urbanism (DGU) in the Ministry of Public Work and this revolves around two complementary planning aspects: the comprehensive master-plan and the Land Use Plan. It is important here to add that in Lebanon a great number of settlements are done without the existence of Land Use Plans. According to the United Nations (UNDP, 1992), of the 1887 towns and villages in Lebanon, only 204 have approved urban plans. These plans cover almost all the towns with at least 10.000 inhabitants and larger, but with respect to the total land area of Lebanon, more than 90% has no approved plan yet.

Table 3.1

Land Management in Lebanon

• The comprehensive Master-Plan (Schema Directeur d'Amenagement et D'Urbanisme, SDAU): (Art.7; D.L. 69/93) is a growth management tool applied at a regional scale to guide future development and preserve the physical environment. It is a combination of:	○ General land use plan assigning a preferred distribution of activities, areas of extension, rehabilitation, and preservation. ○ General plan of infrastructure organizing private and public transportation at an inter-regional and extra-regional scale.
• The land use plan (Plan de Detail d'Occupation des Sols, POS), (Art. 8; D.L. 69/83) falls within the general frame of the SDAU. This plan provides for a detailed set of rules and conditions of	○ Delimitation of urban areas relative to agricultural value and irrigation requirements. ○ Protection of agricultural land. ○ Protection of natural and cultural

land use and land development; it subdivides the areas into different zones and sub-zones taking into consideration the following:	resources such as scenic areas, shorelines, riverbanks, natural sites, historical core cities, urban archaeological sites, etc... (Designated mostly as non aedificandi). o Provision of public facilities and utilities (approval of building sites and open spaces). o Provision of an efficient road network. o Control of land development and building code provisions (authorized building densities; height limits, setbacks, etc...). o Specification of land subdivisions regulations and modes of implementation.

Source: Adjust from Republic of Lebanon, 1997

The current construction law (Law Decree 148/83 of 16th October, 1983) allows construction of a total floor area ratio (FAR) to 0.8% on any land outside an approved urban plan. This makes it politically difficult to establish an urban plan comprising a protection or a safeguard that is a decrease of the total FAR to a level below 0.8%. The lack of effective state controls after 16 years of war means that even the approved urban plans are not respected (UNDP, 1992).

The Lebanese National Master Plan (LNMP) project started in 2002 and included three phases: the first phase included the diagnosis of the current situation, highlighting land characteristics and hindrances. In addition a set of land use maps, infrastructure maps, distribution of activities and housing unit maps were developed. The second phase consisted in a first draft of the comprehensive land use plan for Lebanon in the form of scenario-elaboration. Phase three included the final design of the LNMP to be forwarded to the Lebanese Government for approval. In addition a detailed schedule considering the phases of the short, medium and long term implementation, final maps, and data were to be submitted with the plan to the Council of Ministers by the second half of year 2005 for approval. It is the first plan developed in Lebanon that considers the entire Lebanese Territory. The three phases of the project have been accomplished however, due to the unstable political situation and security events (assassination of Prime Minister Rafic

Hariri, and other political figures), that have occurred since February 2005; the plan is still waiting for approval (Republic of Lebanon 2004, b).

In its summary report, the LNMP committee considers, among its aims, "the National Territory as the Lebanese people's common heritage. It is the duty of every Lebanese generation to hand it over, with all its richness, to future generations. This involves the rational use of the land and its development through ways that would not alter its character or the potential that it represents." (Republic of Lebanon 2004, b, p.1). The committee considers also that the population growth impact on non-renewable resources is huge in contrast with the very limited Lebanese territory. The major objectives set by the committee for the LMNP are as follows (Republic of Lebanon 2004, b, p.2):

- Unity in the country
- Balanced development of regions
- Optimal and sustainable exploitation of resources
- Reduction of State's debts
- Improvement of productivity and economic growth
- A more even foreign trade balance
- Improvement of living conditions
- Protection of the environment
- Preservation of the heritage

Furthermore, the plan proposes four zones according to their fundamental characteristics, considers the potentials of each zone and constraints related to the current situation (Republic of Lebanon 2004, b, p.2):

- The urban zones
- The rural zones
- The agricultural domain of national Interest
- The national areas of national interest

The LNMP recommendations based on the objectives set considers the following (Republic of Lebanon 2004, b, p.10-17):

- To strengthen of the city of Tripoli considered as the Capital of the North and the "Counter-magnet Cities". This would entail a balanced distribution of the industrial and cultural activities as well as the commercial activities. It also considers the improvement of transportation networks such the railways, and the completion of the existing highway to cover the totality of the Lebanese territory.
- To give the capital region the position it deserves. This would necessitate the completion of the reconstruction of the Beirut Central District and the creation of large urban projects in the Northern and Southern suburbs of Beirut. Upgrading the transportation network of the city of Beirut. The review of the regulation related to the urban expansion areas to the North and the South of Greater Beirut.
- Develop the regions, cities and villages. The development would be organized within a hierarchical urban structure (large agglomerations which function is to set the pace of development, secondary cities relatively specialized, and local poles, and villages surrounding the poles) based on the population living in the cities, preserving the character of these cities (traditional) and the activities.
- To reconsider transportation network and categorize the roads into the highway (existing coastal highway) and expressways in order to shorten distances and accesses to the highway. It is also seriously considering public transportation expanding it to all the Lebanese Territory.
- Concerning the water, electricity, and sewage networks, the LNMP recommends the rehabilitation of the existing networks, and the implementation of existing irrigation schemes. In addition, it recommends the construction of artificial lakes and dams between hills, and the review of the planned sewage plants, giving priority to the protection of ground water resources.

- The LNMP recommends that partial reliance on recycling of solid waste will have to be considered along with the selection of adequate landfill sites. In addition, the review of the policy of quarries will have to be undertaken.
- Concerning the Environmental protection, the LNMP proposes the creation of a Natural National Park in the North, and encourages the municipalities to create regional parks. Along the coastal line, the LNMP requires the dismantling of illegal buildings and installation from the public maritime domain and establishing a free public access. It also considers a reforestation of the 'Cedars' Corridor" between 1600 and 1900 m altitude.
- The LNMP will have to generally guide urban planning policy in Lebanon and be the basis for future planning regulations. The plan requires also the review of the construction in the areas that are not covered by land use planning and local urban regulations. Finally, limits are set for the dispersed urbanization encroaching agricultural lands, and natural areas, to reduce infrastructures costs and negative impacts on natural resources, and linear urban expansion on the inter-urban roads to decrease travel time and enhance traffic security.

Although 'Modernist' in its approach, and to its credit, the LNMP is the first comprehensive plan that considered the Lebanese territory. In general, its principles and main objectives maybe very ambitious, and superficially in line with the principles of sustainable development, however a closer scrutiny of the plan reveals that there are still huge gaps in terms of sustainable development principles. The LNMP is not inclusive and does not consider the main dimensions of sustainability from a holistic point of view; it mainly tackles the physical environment disregarding social issues. The plan gives priority to the economic growth at the expense of social welfare (Abdel Khaled, 2003). Abdel Khaled (2003) argues "that this vision cannot be complete if it does not include concerns for marginalized groups, such as women, youth, the elderly, the disabled, and the poor" (p.53). Furthermore she adds that the LNMP "emphasizes balanced regional development and private enterprise as main objectives, but excludes from its objectives the concepts of social equity, sustainability, poverty eradication, rights to housing, and environmental concerns" (p.53).

CDR and IAURIF attempted to follow a participatory approach before the finalization of the LNMP. However, this was limited to informing public agencies about the project including, the Directorate General of Urbanism, the Economic and Social Council, and certain Municipalities. Details of the plan were debated in Universities, with Municipal bodies, the Chambers of Commerce, and with NGO's. A handbook summarizing the recommendations of the LNMP was also issued in Arabic, entitled the "White Book", and disseminated during the debates (Awada, 2003). Fawaz (2003) argues that "Participation does not mean that planners should be limited to presenting the master plan to the community as a final set of drawings that are immutable (save for some cosmetic changes); instead they should seek the active involvement of the community in shaping the outcome of the plan.

Furthermore Srour (2003) argues that, both Dar al Handasah and the IAURIF did not engage the municipalities or other public agencies through the process of planning. Infrastructures such as roads, electricity, water, and wastewater management were politically-driven, and inconsistent with the local administration's preferences (Arbid, 2003, Srour, 2003). In addition "wastewater sector is being developed haphazardly, irrespective of environmental considerations and the management capacity of relevant administration" (Srour, 2003, p. 59). Healey and Gilroy (1990), suggest that planners should learn from the interactive skills of social workers and counsellors to develop listening rather than offering prescriptions, and people need to be actively involved in the planning process.

In recommending the control and the improvement of construction development and urban sprawl and informal construction activities, the LNMP lacks any recommendation related to the existing bulk of buildings. The LNMP recognizes the inappropriateness of construction types with respect to the surrounding environment; however it does not give any recommendation on how to deal with the current situation of the built environment, and it falls short in that it considers the built cultural heritage only from the perspective of economic benefits from tourist activity.

3.6 Conclusion

In this chapter the evolution of spatial planning in Lebanon since 1932 was outlined when the first master plan for Beirut was proposed under the French mandate. It is clear from the literature that before 1963 planning was mainly focused on Beirut and considered the three major roads leading to the North, the South, and the Damascus road leading to the hinterland of Lebanon. Hence, planning was concentrated on traffic road patterns. Zoning was the main tool adopted and importance was given to economic growth disregarding environmental protection in general. The heart of the different development plans along the coastal line focused mainly on tourist economy instead of agriculture and industry. The impact of ineffective top-down "Modernist" urban planning approaches, that continuously favoured local elitist groups (politicians mainly, and landowners), emphasizing physical building and redevelopment, disregarding social and community interests, and lacking environmental protection measures, resulting therefore in the degradation of the physical environment (built and natural environment), are obvious in the literature.

The disregard for building laws encouraged by periodical regularization of illegal construction due to a prevalent attitude of "laissez faire" (public sector and administration) and rampant mercantilism (landowners and real estate speculators) whereby land is considered as a commodity to be exploited to its maximum capacity without regard for the natural and man-made environment was also clear in the literature. Most damaging was the chaotic and uncontrolled development of rural and suburban areas during the war; unregulated construction sprang up (reaching in some places fifteen stories) encroaching agricultural land, along coastal strips, up the scenic mountain slopes, destroying forests and beach land. Rural density increased hugely through illegal additions both vertically and horizontally encroaching on public property, and imposed setbacks.

The latest Lebanese National Master Plan (LNMP), which is still to be approved by the council of ministers, was also analysed and it was clear that although

this plan have considered for the first time the Lebanese territory in a comprehensive manner, it lacked a holistic approach in including the main principles of sustainable development. People participation is virtually non-existent in that they do not participate in the decision making process. Environmental protection is largely ignored, and rehabilitation is considered less as a strategy for breathing life into existing stock of buildings. The problem is probably inherent in the concept of Master Planning itself as an approach to deal with urban development, which seems to be inconsistent with the principles of sustainability. Master planning as a methodology entails a top-down approach where the planner is considered "the expert", in contrast with a sustainable approach to urban development which considers the city as a process, master planning "promotes the scheme as a product" (Giddings, 2002).

CHAPTER 4

CURRENT STATE OF THE BUILT ENVIRONMENT ALONG THE LEBANESE COASTAL ZONE (LCZ)

4.1 Introduction

"If we wish to exist in harmony with our environment, we must do by choice what our ancestors did out of necessity, design with climate and with a sense of place. If we miss this, we miss out on many sustaining qualities of the natural context of site and surroundings" (Oktay, 2002; p.1003)

The built environment is directly affected by socio-economic and regulatory factors, as well as geographic, climatic, and sensory factors (Ching, 1991). The aim of this chapter is to analyse the current state of the built environment along the LCZ through the study of the geomorphologic, population distribution, and climatic factors. Understanding the current state of the built environment will help us appreciate the characteristics of the built form which will imply the appreciation of the problems and probably lead us to possible solutions. The comparison between traditional technologies and know how and modern technologies concerning their efficiency with respect to natural resources will help substantiate the assumption that the modern approaches to building and urban design along the LCZ reflect unsustainable patterns.

The literature on the subjects of the natural and built environment in Lebanon has been enhanced in the past ten years due to an increased awareness in environmental issues. The studies were mainly sponsored by intentioned donors and loan agencies among which the World Bank, the United Nations Development Program (UNDP), and the European Commission (EU). This section will analyze this data including maps and photographs and will be supported by site visits observations and photographs.

4.2 The Lebanese Coastal Zone (LCZ).

Following from the general introduction of the geomorphology of Lebanon, this section will define the extension and depth of the LCZ for the purpose of this thesis. It will first describe the geomorphologic character, the population growth and urban development along the LCZ. It will then look at the climatic variations and the micro-climatic features that are generated by the various configurations of hills and valleys along the LCZ. This allows the bio-physical environment of LCZ upon which the built environment impacts to be fully captured.

4.2.1 Geography and Morphology

The Lebanese territory is a narrow strip of approximately 10452 square kilometres with its maximum width reaching 70km, and its coastal line estimated at approximately 210 km. The geo-morphology of the Lebanese territory is characterised by two parallel faults: Mount Lebanon and the Anti-Lebanon (appendix 1). The volcanic lava and basaltic black stone determined the external aspect of vernacular architecture of northern Lebanon, while lime-stone in architecture was used along the coast and in Mount-Lebanon. Earth is the construction material used in the vernacular Architecture of the Bekaa valley, a flat-bottomed alluvial and fertile plain, is flanked by two mountains the Mount-Lebanon and the Anti-Lebanon (Liger-Belair, 2000).

The Morphology of the LCZ is particular for its diversity. Along the coastal line and parallel to it runs the western mountain range. Several valleys crossing the Western mountain range were created by the numerous water courses that cross this massive calcareous mountain, dividing the country into separated physical parts and creating important natural barriers.

Figure 4.1 captures the inner parts of one of the few preserved valleys along the LCZ. The Nahr el Kalb river valley is among the natural sites considered by the UNESCO as protected non-aedificandi areas.

Figure 4.1

Nahr El Kaleb (El Kalb River) valley

Source: El Asmar, (February 2004)

However, this is not the case for all the natural valleys and sites along the LCZ. The aesthetic serenity and beauty of the valleys are under stress due to the irregular encroachment of high rise residential buildings (figures 4.2, and 4.3). Rivers are polluted by waste-water and other effluents discharged directly into the rivers. Deforestation and erosion are caused by the opening and expansion of roads networks.

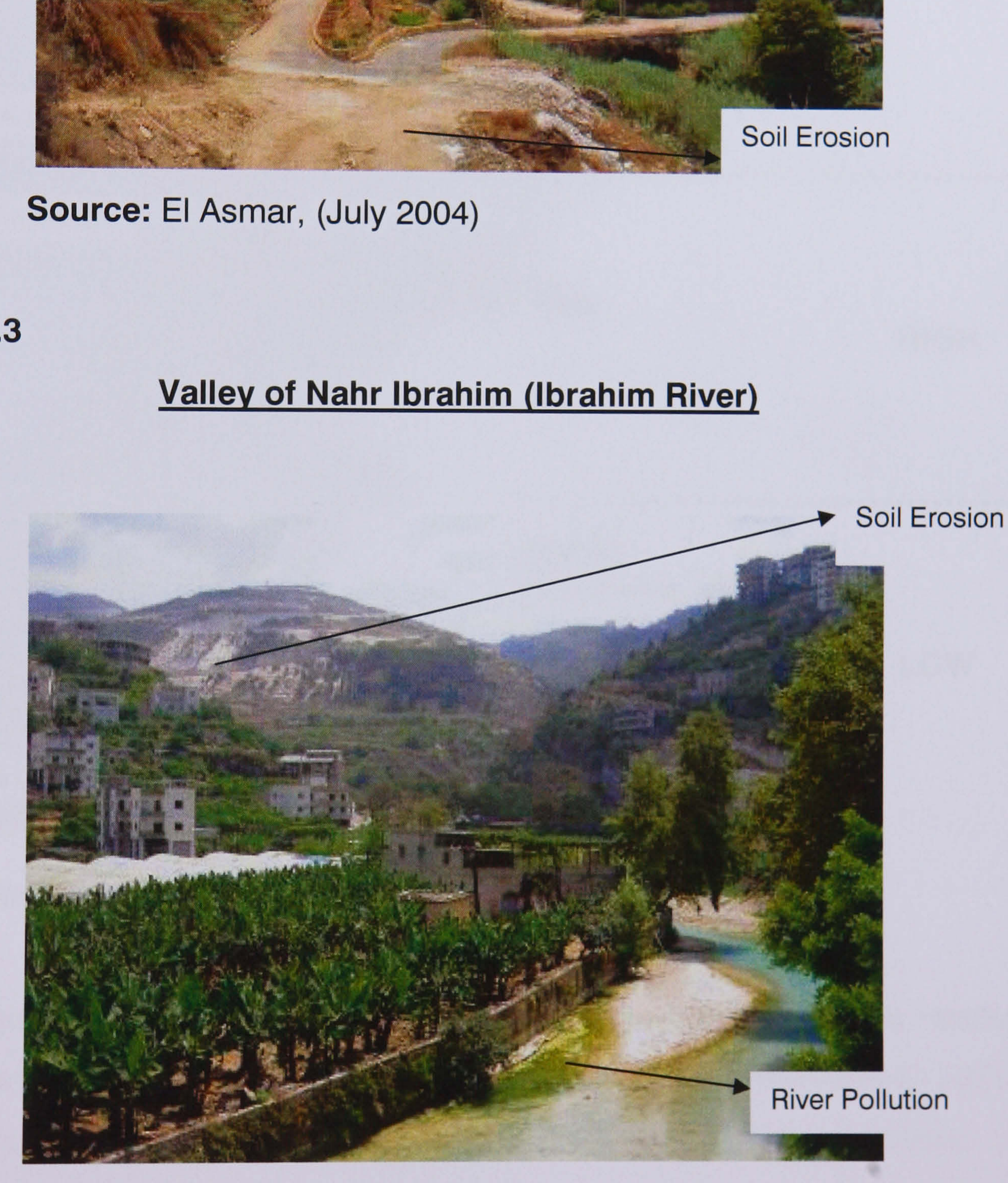
Figure 4.2

Valley of Nahr El Fidar (El Fidar River)

Source: El Asmar, (July 2004)

Figure 4.3

Valley of Nahr Ibrahim (Ibrahim River)



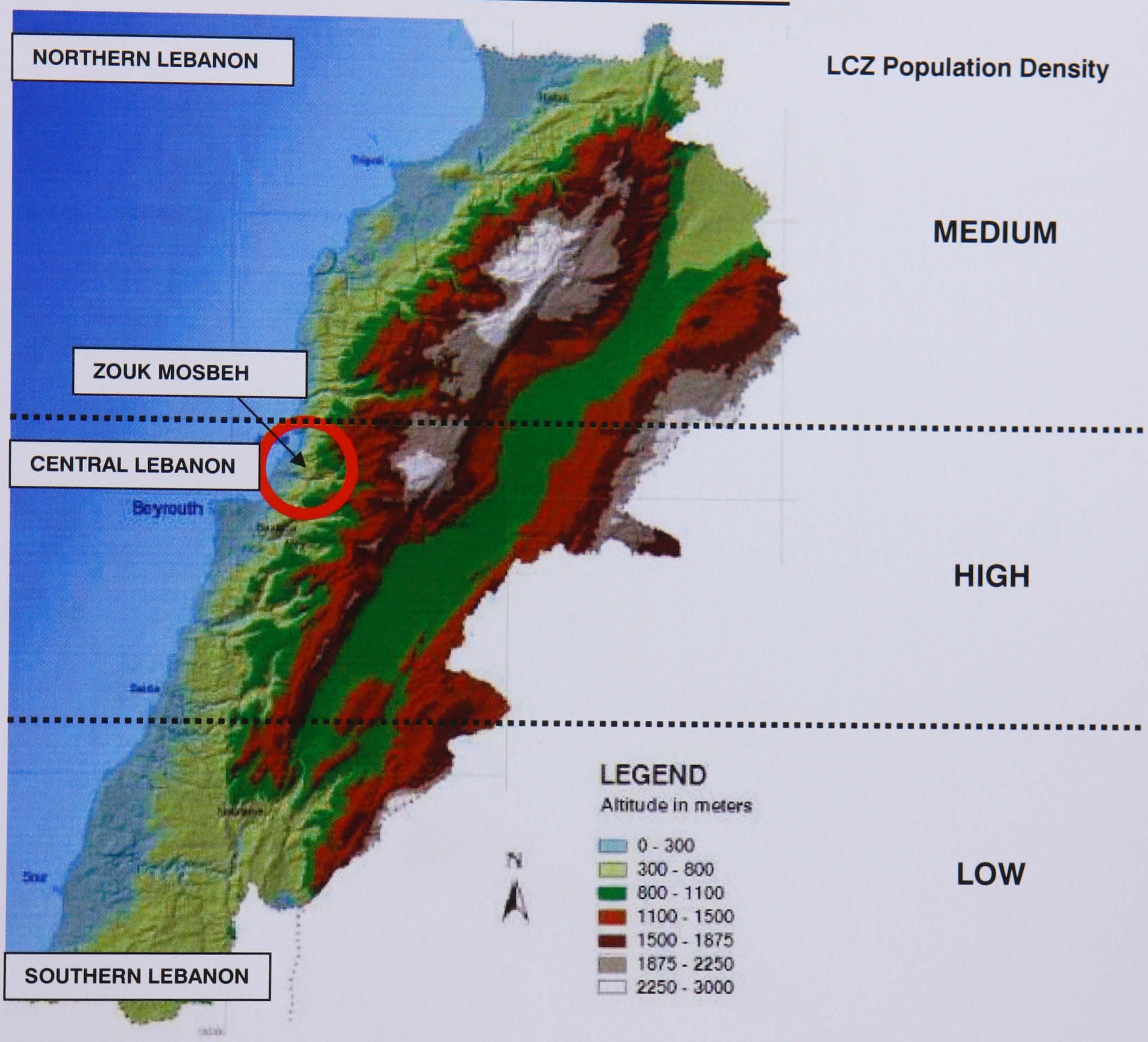
Source: El Asmar, (July 2004)

Figure 4.4 shows the morphology of the Lebanese territory. Its division into three was decided in relation to the density of the population and urban

development (figure 4.5). The red circle indicates the coastal area of Zouk Mosbeh[6]. The light green area on the left of the map represents the LCZ, which is the area under study and it is about 300m altitude from the sea level..

Figure 4.4

Morphological Map of Lebanon



Source: Republic of Lebanon, 2002

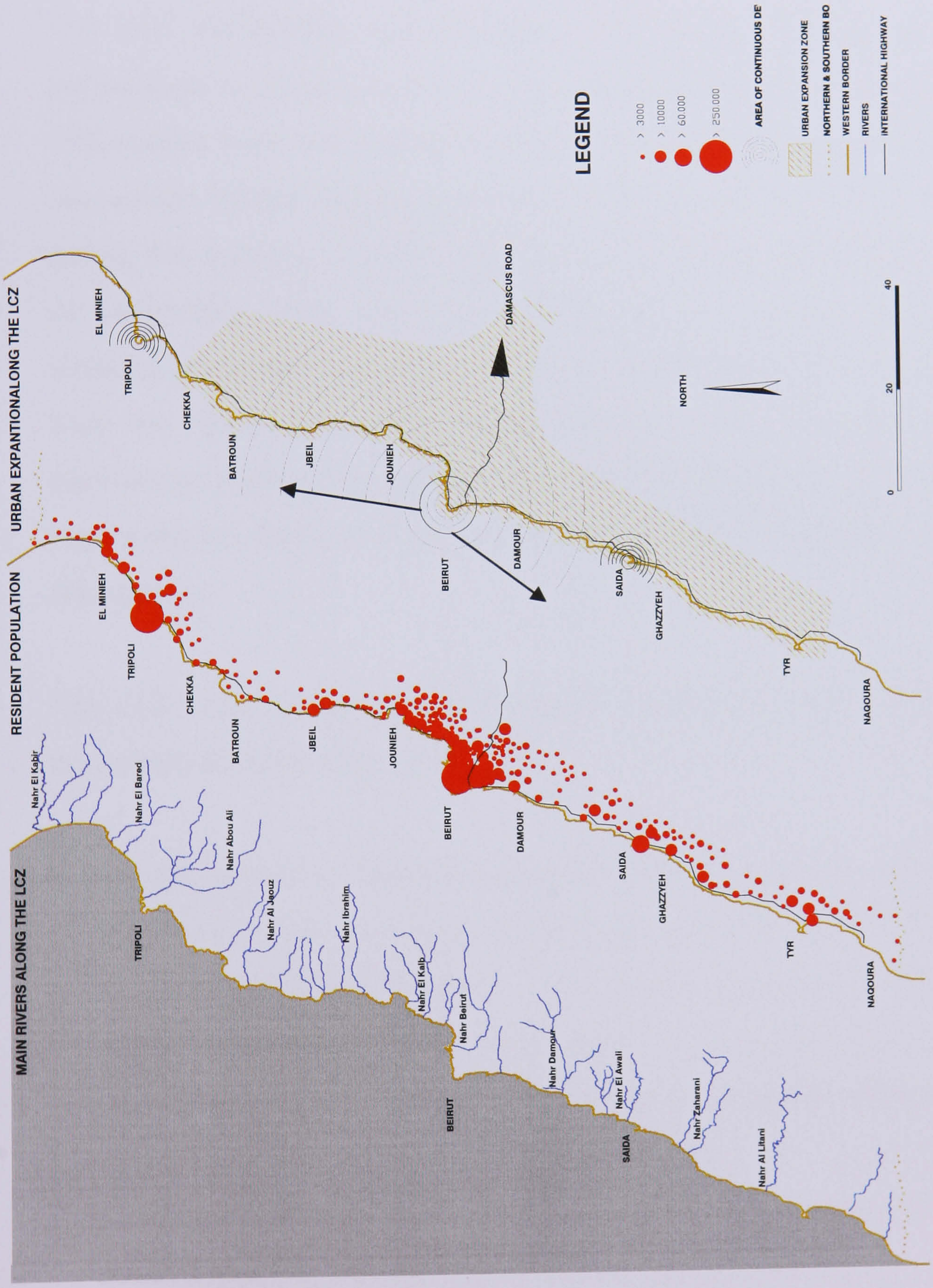
As per figure 4.5, the Northern part of Lebanon has medium density relatively to the central part. The central part, comprising the capital Beirut with its northern and southern expansions, has the highest population density and urbanization rate. However, the southern part of Lebanon, which includes the areas that were occupied for several years by Israeli invasion, forcing people to leave the area and experiencing accordingly almost no development for years,

[6] The case study will be conducted in the coastal area of Zouk Mosbeh

is the less densely populated and urbanized. Figure 4.5 shows also the main rivers along the LCZ. The two arrows on the first partial map show the urban expansions of the capital Beirut.

Figure 4.5

Changes to Physical Structure of Lebanon



Sources: Republic of Lebanon, 2002, and Saliba, 2003.

For the purpose of this study the Lebanese Coastal Zone (LCZ) is defined as the narrow strip along the Mediterranean Sea reaching 225 km in length and 1.25 km average width and the altitude of approximately 300m encompassing the first peripheral growth zone of residential development on the mountainside overlooking the seashore. This definition is related to the extent of the urban growth of the coastal Lebanese cities.

The LCZ constitutes approximately 16% of the National surface area (this percentage is directly related to the altitude which in this case reaches around 300 meters from the sea level) and is inhabited by approximately 75% of the population mainly distributed between the capital city Beirut and two regional poles, the northern city of Tripoli and the southern city of Saida, and a number of secondary cities such as Tyre, Damour, Jounieh, Jbeil, Batroun, and Chekka. A coastal highway runs 160 km along the LCZ from the south, starting from the city of Tyre to the north bordering Syria. From this highway, a main transversal road connects the LCZ with the hinterland, as shown by the link road between Beirut and the city of Zahle in the Bekaa valley, and continues to Damascus.

The LCZ could be divided on the basis of population, urban development, and economic activities (figure 4.4):

- Central Lebanon: between the Awali River in the south and Al Jaouz River in the north. This part corresponds to the capital Beirut and its northern and southern coastal extension. This area is characterized by a continuous ribbon development on both sides of the highway and defines the backbone of the Lebanese economic and social activities (Republic of Lebanon, 1997). The area is overcrowded with commercial, residential, industrial land use, and tourist compounds, while from Beirut towards the south it reaches the fertile plain of Damour.

A cross section can be repeated along the LCZ and through the main cities and smaller important towns, and almost the same land use and settlements and building typologies, environmental problems can be found,

with very little differences depending on the population density and concentration of activities (Republic of Lebanon, 1997).

- Northern Lebanon: the coast extends from Al Jaouz River up to the borders with the Syrian Republic. This area is of mixed use comprising agricultural land, industries and tourist infrastructure.

- Southern Lebanon: this part starts at the Awali River and reaches the southern borders of the Lebanese territory. This area is rich in agriculture and following the Israeli withdrawal in year 2000, it is experiencing a residential boom which is encroaching on agricultural land especially near the two main cities of Saida and Tyr.

The LCZ hosts four commercial ports and over 15 fishing harbours, dozens of sea pipelines for petroleum imports, three fuel power plants, and series of various industries. Apart from being endowed with beautiful natural landscapes and rich cultural and archaeological heritage, it also remains the main drinking water source for the country (Republic of Lebanon, 1997).

4.2.2. Population growth and urban development along the LCZ:

Since the middle of the 20th century, Lebanon has experienced an average urban growth rate of 8.14% annually. This phenomenal growth rate is attributed to the centralized nature of its economic and political systems. Similarly, the distortion effects to rural life by the civil war and attendant political upheaval has also forced rural-to-urban migration. In particular, the civil war which lasted from 15 years and the Israeli invasions of 1978 and 1982 resulted in the internal displacement of almost one million people. More worrisome is the distortion to the growth patterns of cities, which swelled to overwhelming levels (Global IDP 2004).

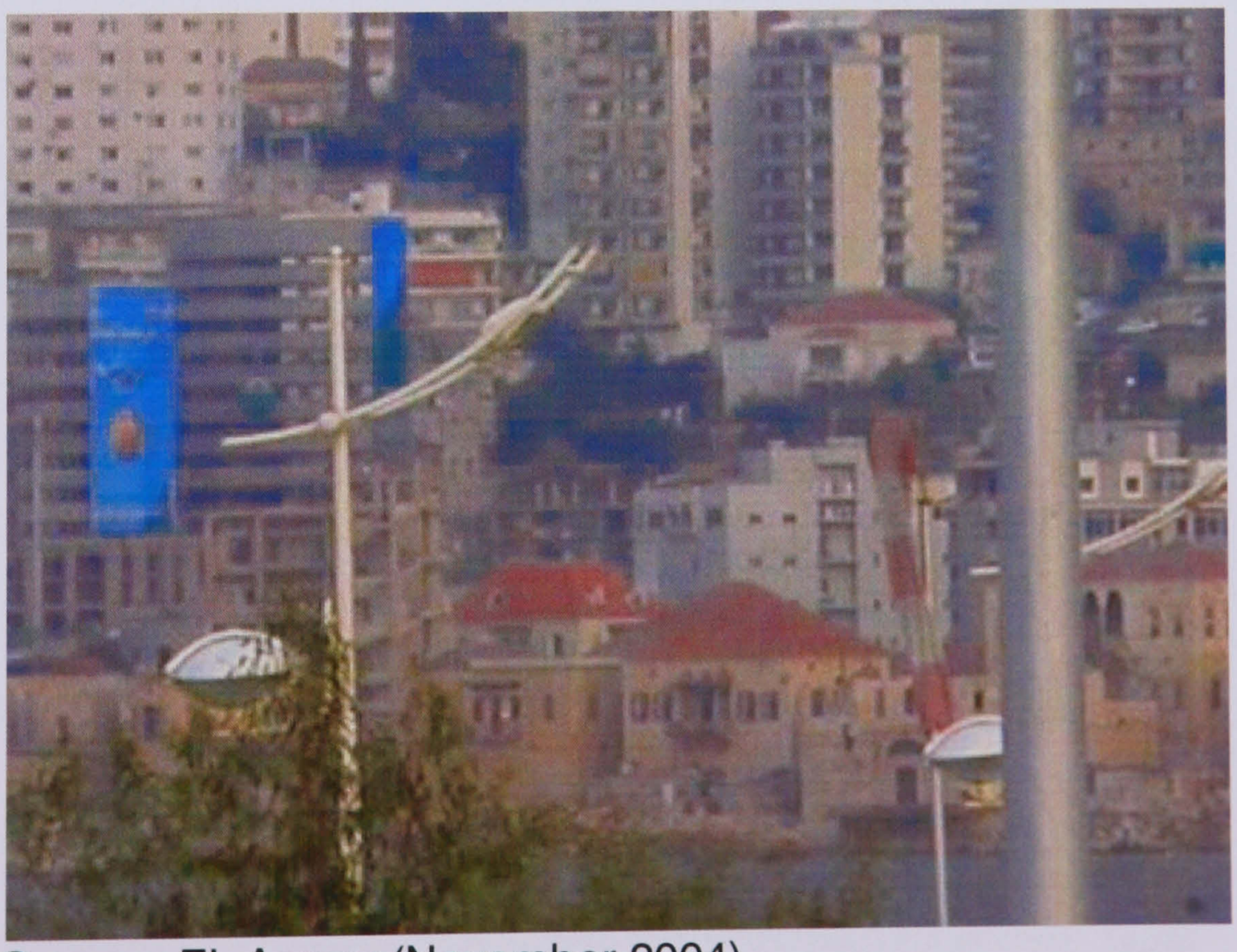
Although there is paucity of data but Global IDP (2004) has attempted a map and pattern of internal displacement in Lebanon. Accordingly, 62% of these people originate from the Mount Lebanon region while 24% originate from Southern Lebanon. Nevertheless, it is estimated that approximately 79.500

displaced people returned to their places of origin. However, the movement of people has overwhelmed Beirut, especially the lack of urban planning and coordination, resulting in urban sprawl and uncontrolled urban expansion (Republic of Lebanon, 1997, 2001). As Figures 4.6, 4.7, 4.8, and 4.9 are vivid demonstration of the huge expansion and overcrowding that have taken place in Lebanon.

For example, Figure 4.6 shows numerous high density high-rise buildings that have been put up only in the last 10 years that continues to dwarf traditional buildings while encroaching on the natural environment. The typology of these buildings can be seen to be totally devoid of context whether traditional, climatic, or aesthetics such that these new buildings alter and transform environmental attributes and characteristics of the areas in question. This is particularly so when many of these buildings are left uncompleted helping to fuel urban aesthetic pollution and urban chaos.

Figure 4.6

Jounieh Bay from Automobile Transportation Lebanese Club



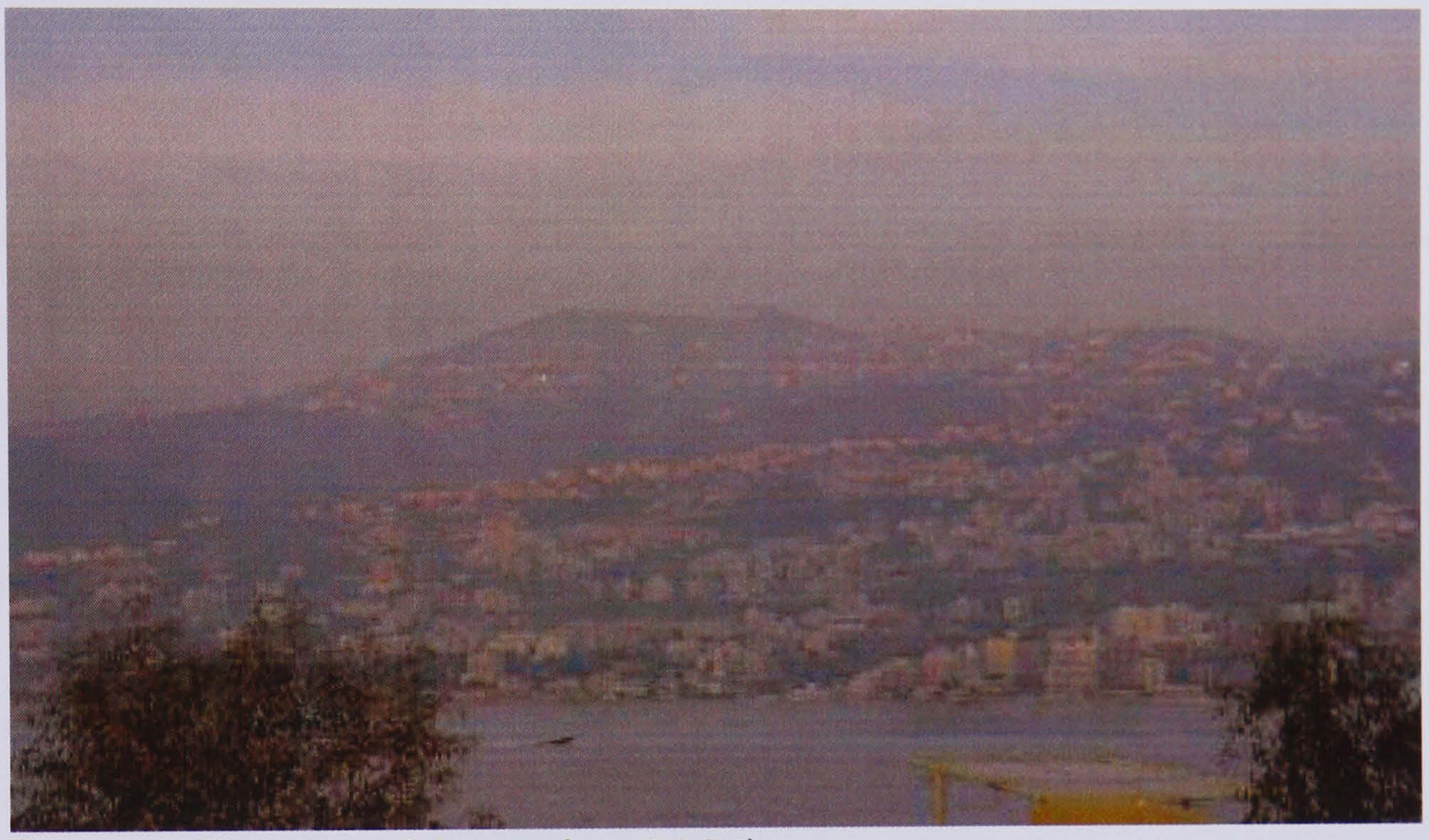
Source: EL Asmar (November 2004)

Similarly, Figure 4.7 and 4.8 show clearly the extension of urban sprawl represented by the encroachment of building to areas that were completely

green and virgin land less than 15 years ago. In particular, housing developments can be visualised even at the top of the mountain range.

Figure 4.7

Jounieh Bay from Automobile Transportation Lebanese Club



Source: El Asmar (November 2004)

Figure 4.8

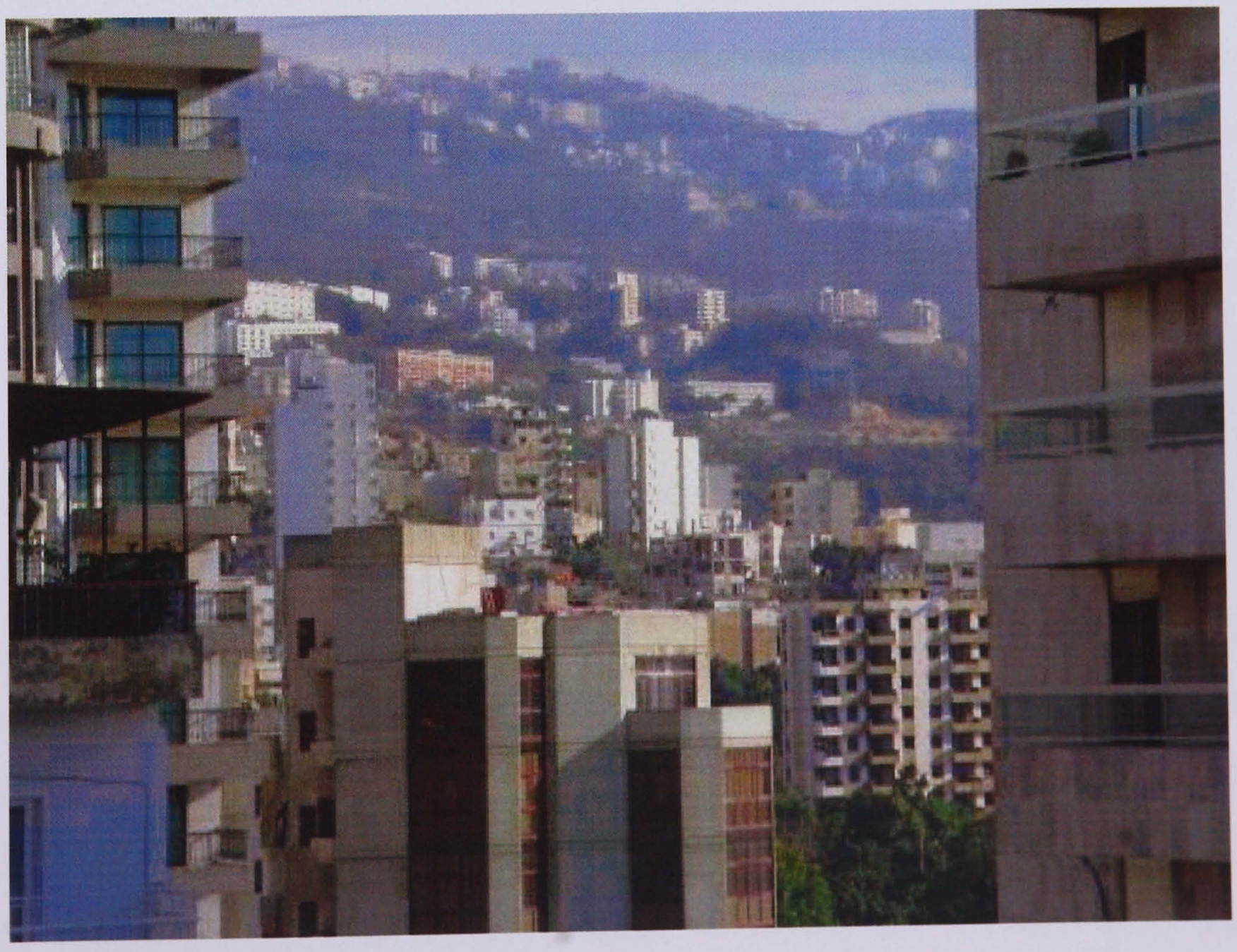
Beirut towards the North

Source: El Asmar (October 2004)

Figure 4.9 further demonstrates the types of materials that have been used for housing construction, which embody huge energy in contrast with traditional stone buildings that use in-situ materials. Embodied energy being the energy consumed by all of the processes associated with the production of a building, from the acquisition of natural resources to product delivery. This includes the mining and manufacturing of materials and equipment, the transport of the materials and administrative functions. Embodied energy is a significant component of the lifecycle impact of home. Reinforced concrete masonry embodied energy is more than 200 GJ while to stone masonry is around 100 GJ (Australian Government, 2005). Also evident in Figure 4.9 is the lack of planning input to these buildings given their close proximities and the shadows that preclude use of solar energy and a huge obstacle to natural ventilation and airflow. These factors are crucial in designing passive ventilation and low-energy buildings.

Figure 4.9

Beirut towards the East



Source: El Asmar (October 2004)

4.2.3. Micro and Macro-Climate of LCZ

The need to consider micro and macro climate conditions of LCZ hinges on the influence of climatic factors on ways that buildings use energy and hence the comfort of the occupants. It is important to distinguish between the regional scale or the macro-climate and contextual scale or the micro-climate when analysing the environmental factors which have impact on a certain site (Moore, 1993; Goulding et al., 1993). Moore (1993) considers that "Natural features such as earth forms, vegetation, and water can be used to uniquely affect the temperature, sun, humidity, and wind conditions of each site"(p. 57). The configuration of hills and valleys along the LCZ affects the site orientation with respect to climatic features and meteorological variables (air temperature, solar radiation, relative humidity, wind velocity) which occur simultaneously. Understanding these variations now will enable us appreciate issues relating to thermal comfort later in the thesis.

The geographical location of Lebanon on the Eastern coast of the Mediterranean Sea ensures that it enjoys with mild to cold winter and hot summers. A country with this kind of weather has four seasons' winter, summer, fall, and spring. However for the purpose of the study and relying on the climatic data two seasons will be considered in addition to the mid-season (fall and spring) and this is due to the similarities in temperature and humidity values. However, the usefulness of this approach is to indicate the types of passive design strategies and their environmental implications that could be adopted. Second it also would allow us to vary policies and solutions by knowing the geomorphologic characteristics of Lebanon.

Concerning the climate data and climate zoning, and in dealing with these aspects of the thesis, a collaborative efforts between the General Directorate of Urban Planning (government of Lebanon), and the United Nations Development Programme (UNDP) under project (UNDP/LEB/99/G35), will be heavily relied upon[7]. The UNDP project is aimed at developing a thermal standard for buildings in Lebanon and enabling its future adoption through the

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[7] I have also collaborated on this project, within a team NDU/Prime Design, in developing the technical design guide "Climate and comfort: Passive Design Strategies for Lebanon"

provision of capacity building and information dissemination. Among the activities, a climatic zoning for buildings in Lebanon was developed. The methodology for developing Lebanon's climatic zones included the following:

- Review of the four main climatic parameters that affect heating and cooling energy requirements in buildings, namely air temperature, solar radiation, relative humidity, and wind velocity

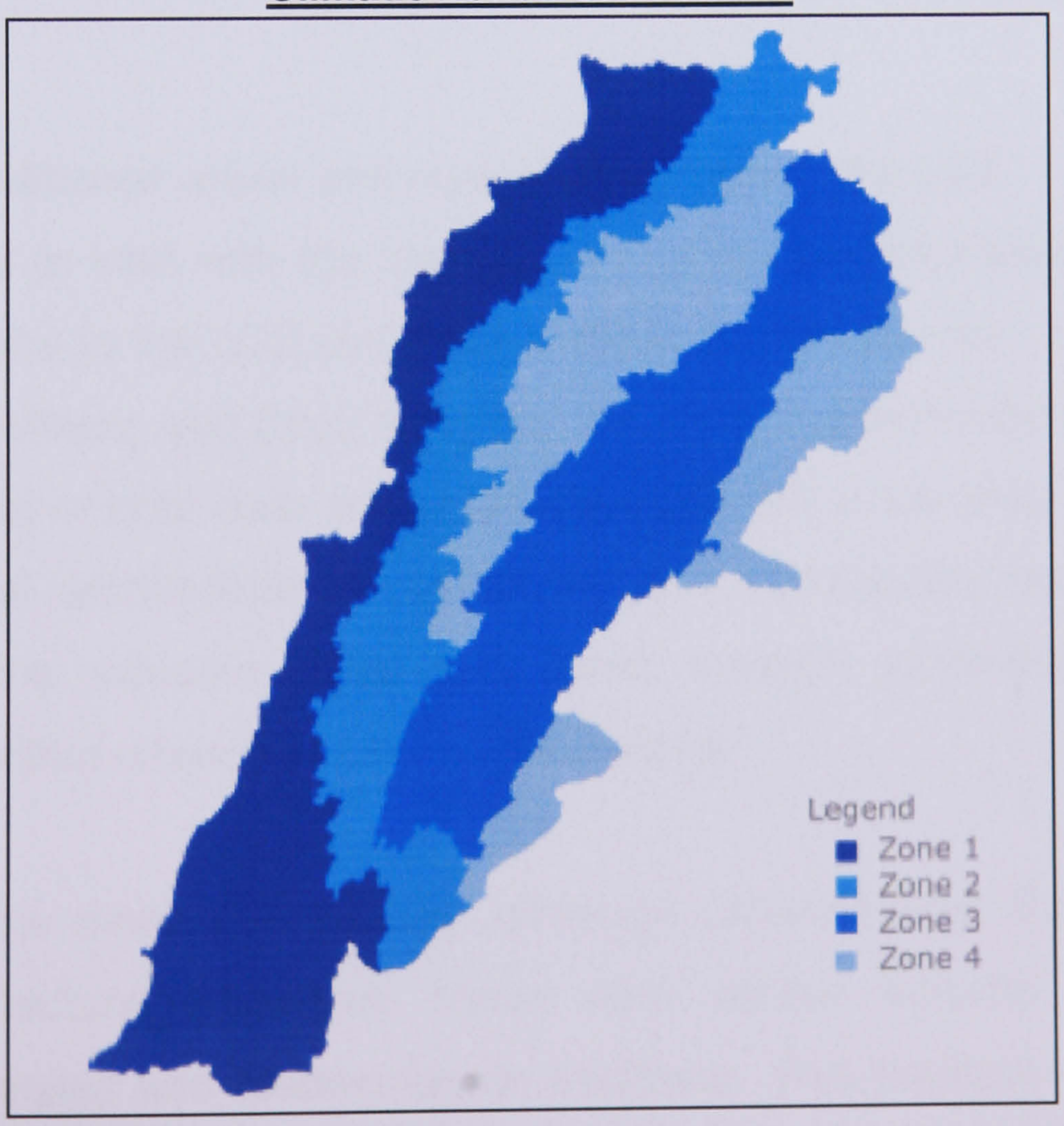
- Selection of a comparative evaluation of the thermal energy requirements of buildings based on heating degree days and cooling degree days

- Analysis of the index value and selection of the number of climatic zones

- Delineation of the contours of the climatic zones (figure 4.10) based on altitude threshold and administrative areas (The Republic of Lebanon, 2003).

Figure 4.10

Climatic Zones of Lebanon



Source: Republic of Lebanon, 2003

Figure 4.10 identifies four different zones;

- Zone 1: the coastal region (LCZ) is defined as having less than 1000 degree days
- Zone 2: the mid-mountain region is defined as having between 1000 and 2000 degree days
- Zone 3: the high-mountain region is defined as having more than 2000 degree days
- Zone 4: the inland region which is also defined as having 1000 and 2000 degree days

Based on this study the LCZ or Climatic Zone 1 (altitude 0m – 800m) has a mean annual temperature that varies between 12.5° C during winter and 26.8°C during summer. The variation of temperature between day and night are mild ranging between 6.8°C (winter) and 8.2°C (summer). The coldest month of the year is January while the hottest month is August (Republic of Lebanon, 2003). The relative humidity along the LCZ is mainly constant and oscillates around 70 percent.

4.2.4. Traditional urban and rural settlements in the LCZ

It is important to start with the identification of the characteristics of the main cities and towns in the LCZ and these include, Sidon, Jounieh, Jbeil, Batroun, Tripoli, Zouk Mikael, and Zouk Mosbeh, The form of identification pursued will be the analysis of both rural and urban development of the area. In assuming that traditional architecture is climatically and contextually responsive, this study will give valuable clues and ideas towards achieving sustainable architecture within urban and rural configurations.

Throughout the nineteenth century, although Lebanon went through various foreign architectural influences, these were always adapted to suit local architectural styles and Mediterranean traditions. This tradition is exemplified by simple spatial shape yet integrated within a specific architectonic typology and spatial organization context. Such transformation endured and maintained

its essential traditional constants of integration, density and shape (Moukarzel, 1992).

Along the LCZ are two types of traditional human settlements. The main coastal cities and towns; open to cultural influences from the Orient and the Occident. The rural towns, which are on the foothills of the western mountain range, comprised of detached houses for rural dwellers and these houses are vernacular in characteristics to reflect simplicity, secularism and traditional techniques. An observation that can be made is that these buildings were built on the flanks of the western mountain range facing the Mediterranean Sea, taking account local climatic conditions and the socio-economic needs of rural dwellers. The major activities in rural areas are limited mainly to craft and agriculture.

However, increasing urbanisation is undermining rural capacity. Figure 4.11 clearly show the encroachment on agricultural land where banana plantation is vanishing and rapidly being replaced by medium and high rise buildings. This has enormous implications for rural communities, forcing many from the land and forfeiting valuable traditional skills.

Figure 4.11

Urban encroachment on Agricultural Land

Source: El Asmar (November 2004)

4.2.4.1 Rural traditional typology

Rural dwellers build small retaining stone walls and dividing the steep slopes into agricultural terraces. They built their houses according to their needs and as economical as possible and with minimum impact on the biophysical environment. As Figures 4.12 and 4.13 show that the traditional house is simple with rectangular plan on one level or on two split levels, and a flat roof. The upper level is often used by the family while the lower level is usually for works purposes such as for keeping agricultural tools and animal husbandry and stocks.

Figure 4.12

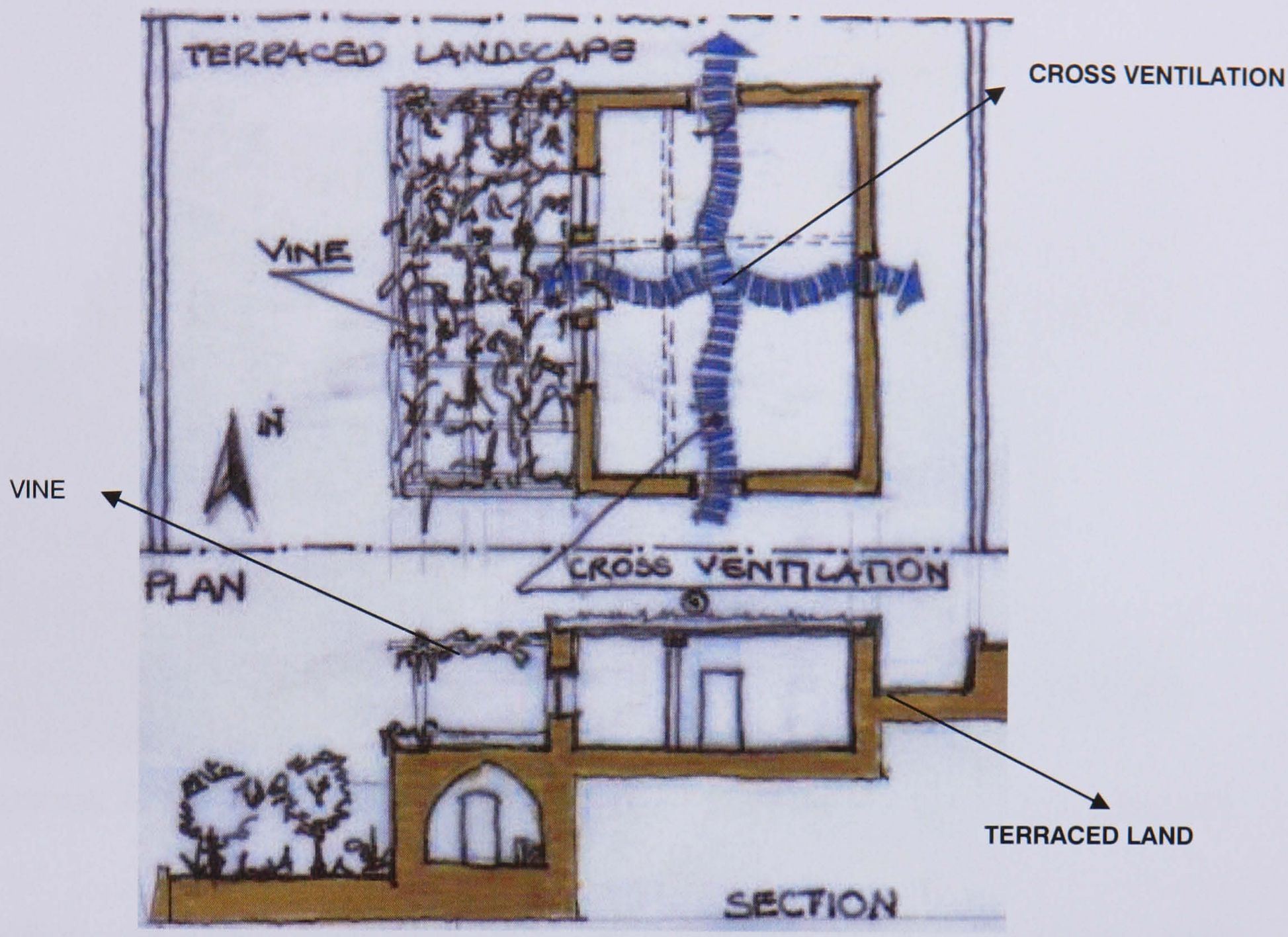
A Typical Traditional Rectangular House

Source: El Asmar (November 2004)

The building technique is very simple though energy efficient; very thick enclosure walls (80 cm to 100cm) consisting of three parts; an exterior layer of stone an interior layer of stone and a core in between filled with rubble. These walls are built with rubble or squared local stone masonry usually without mortar. As indicated by Figures 4.14 the interior walls are usually plastered.

Figure 4.13

Plan and section of a traditional house



Source: El Asmar (November 2004)

The roof, according to Figure 4.14, is usually between 40 cm to 50 cm thick, if not vaulted (figures 4.15) and consist of primary linear structure of wooden beams, a secondary structure of wood strips or more often of reeds or branches, a thick slab made of moist and dry earth. This type of roof required constant maintenance especially after the dry summer period, which is done with a stone roller normally seen on the roof of these houses. The combinations of these materials enhance energy efficiency, passive ventilation, and thermal comfort without mechanical means and consumption of conventional energy.

Figure 4.14

Detailed section of a traditional wall

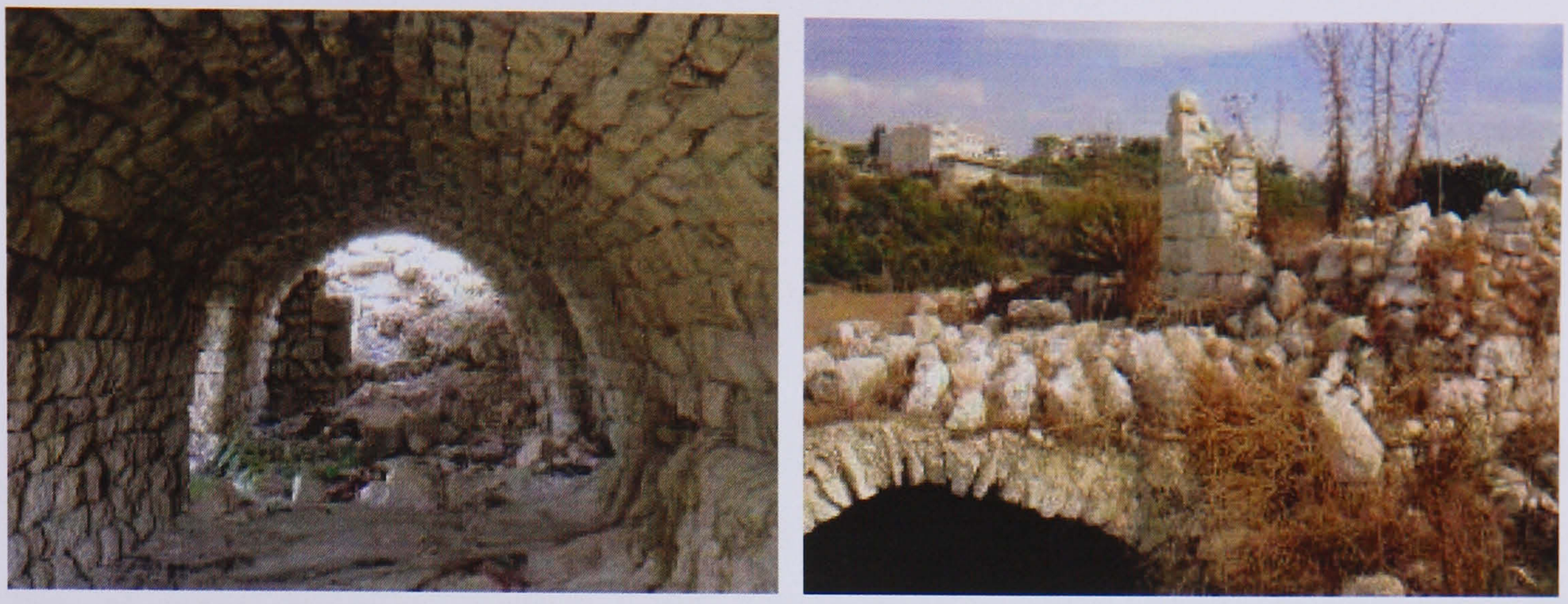
Source: El Asmar (November 2004)

Source: Adapted from Raguette 1980, p.23

Regarding wall, the thickness and the materials of the enclosure walls automatically respond to climatic conditions and acting as a thermal-mass, which has a heat storing capacity. The heat stored in walls and roofs components is delayed by both the thickness and the materials of the building components delaying the propagation of heat. This heat absorbing capacity is such that the daily temperature rise within the house is delayed sufficiently to mitigate the change of temperature between night and day (Moore, 1993). On the coast, daily temperature variations are small and humidity is high during summer, necessitating cross-ventilation, which as Figure 4.13 shows is usually secured by the openings on the four opposite sides of the house. Under such conditions cross-ventilation is facilitated by window arrangements that facilitate easy airflow.

Figure 4.15

Lower Level Vaulted Roof



Source: El Asmar (November 2004)

The presence of vegetation in the immediate environment of a building is very important to enhancing the thermal comfort of the building. Trees provide shade reducing glare, they also provide protection from undesirable wind, filter air absorbing pollution, and attenuate airborne sounds (Ching, 1993). In general the preferred orientation of the longest side of buildings is North-South due to the higher angle of the sun path with respect to the earth surface and thus to reduce direct sun rays into the buildings (Republic of Lebanon, 2003).

Along the LCZ and due to the steep geography of the rural areas, Figure 4.13 shows that vernacular rectangular houses are built with their longer sides facing east west. However, this has the implication of direct sun glare and direct sunlight, resulting in overheating. Nevertheless, this is often overcome by planting vine trees in front of the West elevation of buildings to breaking direct sunrays, reducing heat and glare (Ching, 1993, Moore, 1993, Belair, 2000). In addition deciduous trees can be planted on the south-western side to cast shadows in summer time and allowing solar radiation in winter. This is the reason why all activities such as cooking, socializing, and sleeping are conducted outdoors under the vine in the summer time (Belair, 2000).

This simple typology developed into a more complex one involving a more qualified craftsmanship. Following the introduction of the vaulted lower space (for animals and agriculture stock), the typologies of the second part of the

nineteen's century and the beginning of the twentieth century was mainly influenced by the occident in general and particularly by the Florentine architecture. This was due to centuries of economic and cultural relationship. The influence touches the conceptual level; the symmetry ordering the main elevations, the openings, and the interior subdivision of the spaces (figure 4.16). This development of the traditional architecture maintained its authentic characteristics of simplicity lacking excessive decoration (Moukarzel, 1992).

This typology defined by many authors (Raguette, 1980; UNESCO, 1985; Saliba, 1998) as the "The Central Hall House", became the most prevalent in the country, forming both coastal urban towns, cities, and rural towns. The organization of the functions around the central hall is an expression of the patriarchal structure of the Lebanese family. "It is the Lebanese house par excellence, the type of house most often repeated and attaining the highest degree of identity" (Raguette, 1980; p. 92)

Figure 4.16

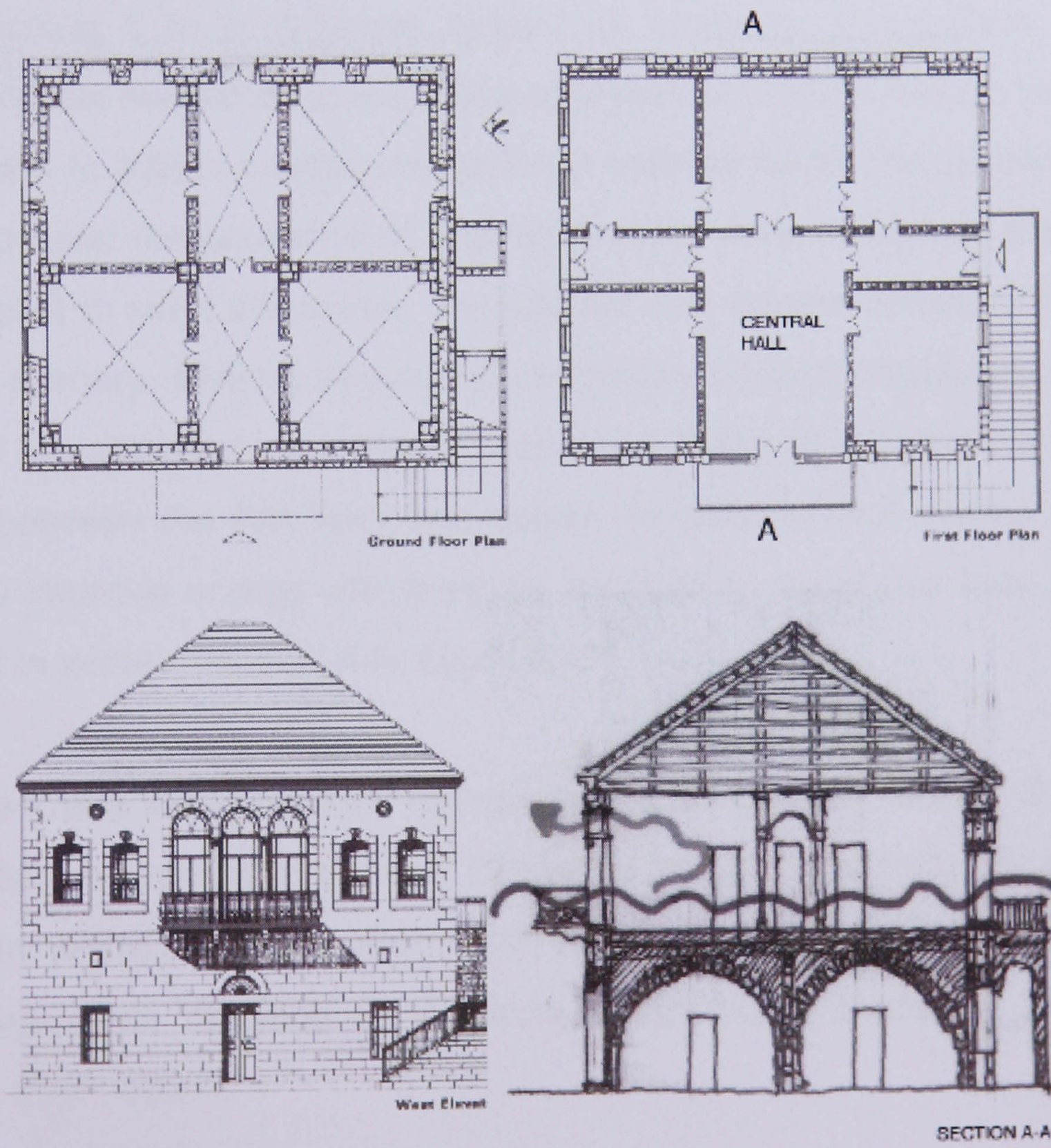
A "Central Hall" house

Source: El Asmar (November 2004)

The plan of the house as in figure 4.17 is usually a square on two levels. The ground level or street level was used either as dwelling or in many cases and especially in towns and cities, as store or craftsman workshop, while the first level hosted usually the house. The entrance of the house is either from the back towards the East or from the Southern side, or the Northern side, giving directly to the central hall which opens the view through the triple arcade towards the sea (West), and extends outside through a corbelled and cantilevered balcony. The arcade is very high reaching almost the ceiling. The windows on the sides of the triple arcade are generally rectangular. Their height enhances ventilation and illumination. Smoke outlets can be found above the windows.

Figure 4.17

Typical "central hall" house



Source: Adapted from Raguette, 1980, p.98

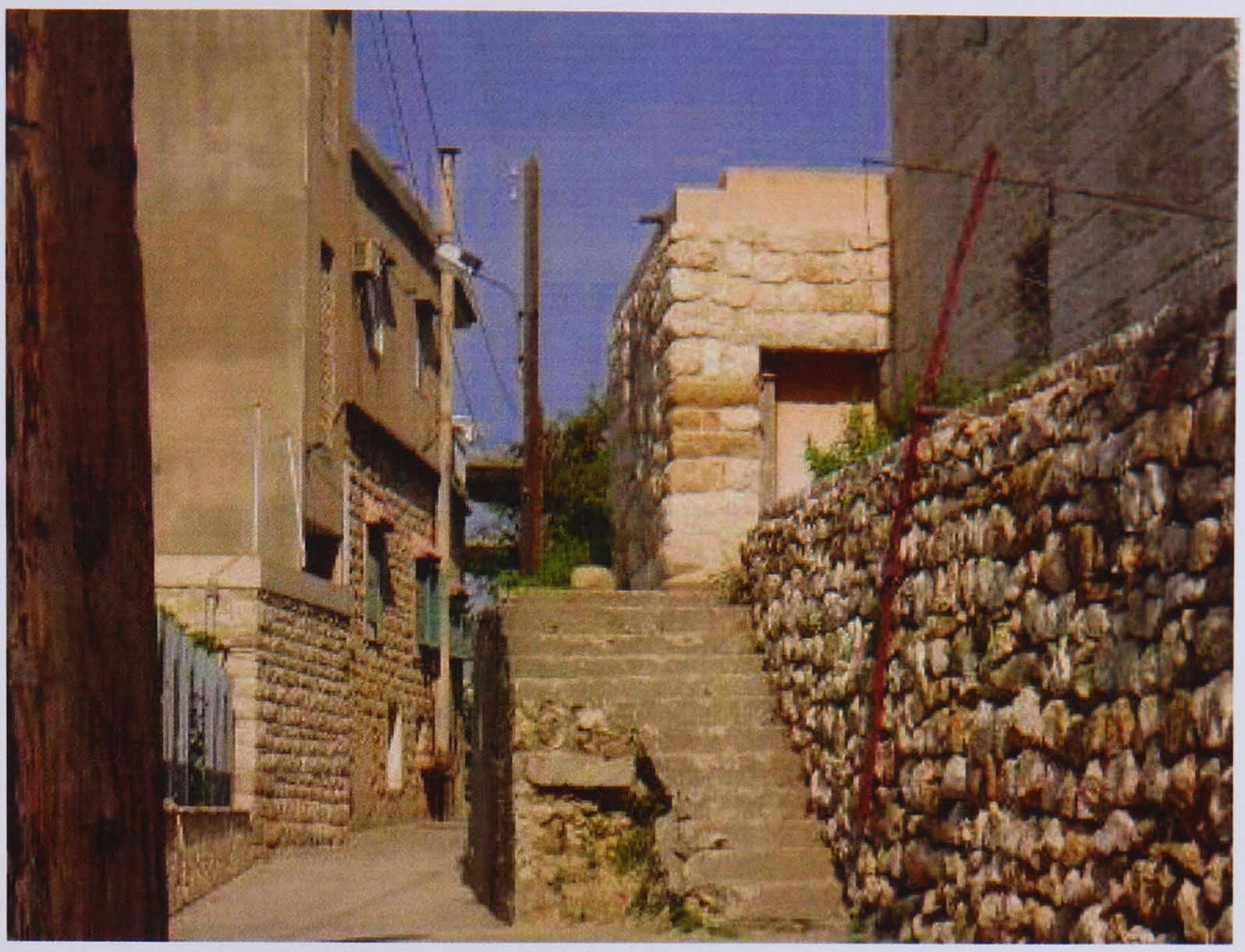
The triple arcade is usually composed of a door in the middle and a window on each side. From the central hall the other rooms of the house can be entered. A pyramidal brick tiled roof will replace the traditional earthed flat roof. In general the Lower level was either vaulted (barrel and in some cases cross-vaulted), or flat with or without supporting arcades, built as seen above with very thick stone walls. The upper level was built of stone, never vaulted it was covered with a timber framed roof with brick tiles; flat roof are very rare and are covered with a vine (figure 4.17).

The cross section of the enclosure walls is the same as the older examples, benefiting therefore from the thickness and materials to act as a thermal mass. In many examples the first floor is built with one layer of cut stone masonry 30 to 40 cm thickness. This change of technology in increasing heat transfer capacity decreasing time lag, reduces energy efficiency. The height of the first floor reaching 5 to 6 m forces heated air upwards. The outlets above the windows allow heated air to exit creating therefore internal natural ventilation of the spaces. In addition cross ventilation is maintained by the openings on four sides; however the presence of internal division walls decreases the efficiency with respect to older structures. The pitched roof system consists of a wooden frame of primary (beams) structures, secondary (rafters) structures and purlins to which are attached brick tiles. A horizontal frame of wooden planks divides usually between the first floor and below the pitched roof leaving a huge air space to improve energy efficiency by decreasing excessive heat in summer and cold in winter (Section A-A; figure 4.17).

The rural towns along the LCZ along the foothills such as Ghazir, Zouk Mikael, Zouk Mosbeh, were planted near bodies of water; agriculture being the main economic activity. The houses were built on the rocky lands to preserve agricultural land; resulting in a dense urban fabric clustering families into quarters (FNP, 2001).

Figure 4.18

Internal road in Zouk Mosbeh



Source: El Asmar (November 2004)

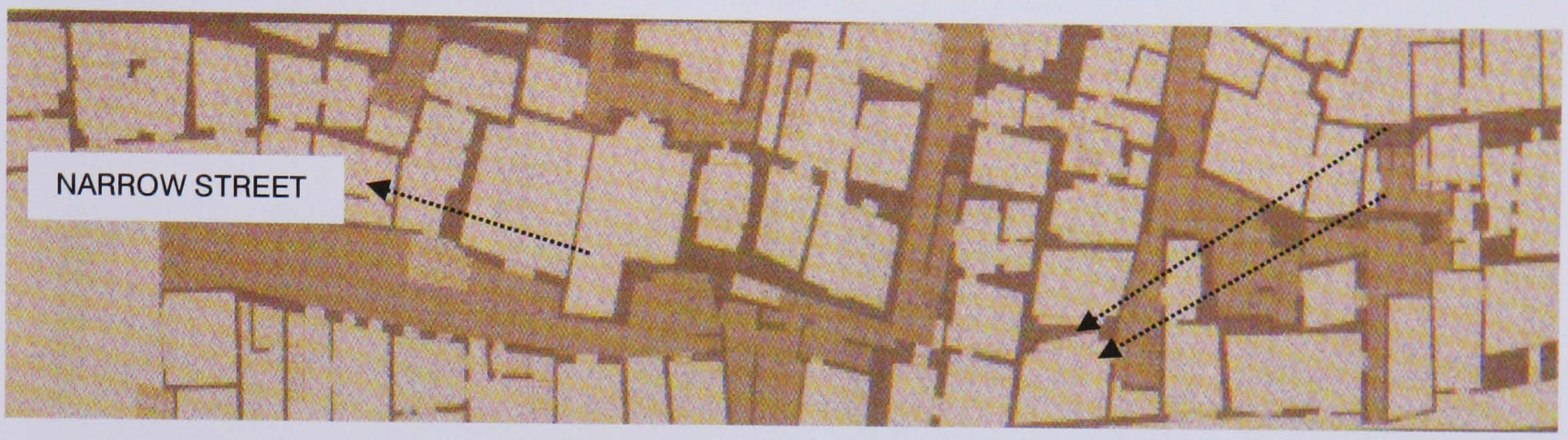
The streets resulting from this arrangement are very narrow, thus creating areas of shadow, and ventilation corridors, beneficial during summer, especially that people in these towns live most of their day outside on the terraces or along these streets, this type of arrangement allowing for social interaction, and enhancing social and cultural sustainability. Figure 4.18 shows a narrow street crossing between clusters of traditional houses in the rural old centre of Zouk Mosbeh.

The main cities along the LCZ, Sidon, Beirut, and Tripoli were built around harbours, and expanded up to the mid of the nineteenth century within reinforced city walls. The urban fabric of these cities was conceived similarly to the ottoman approach, whereby a very dense urban fabric is dominant defining the shape of the urban voids (Figure 4.19). Religious and governmental buildings are the only physically visible landmarks defining the cities' skyline. In the second half of the nineteen century, residential quarters developed in the peripheries of the central cities.

The central part of these cities is divided into two levels the ground level is occupied with commercial or craft activities. These markets "Souk" developed linearly and are partly covered pathways; they constitute the back bone of the city and from these narrower streets and stairs extend taking to the back or to the upper levels. In many cases these narrower streets reach interior courts from which the house can be accessed. Figure 4.19 and 4.20 show the arrangement of the inner city of Sidon into narrow streets (FNP, 2001).

Figure 4.19

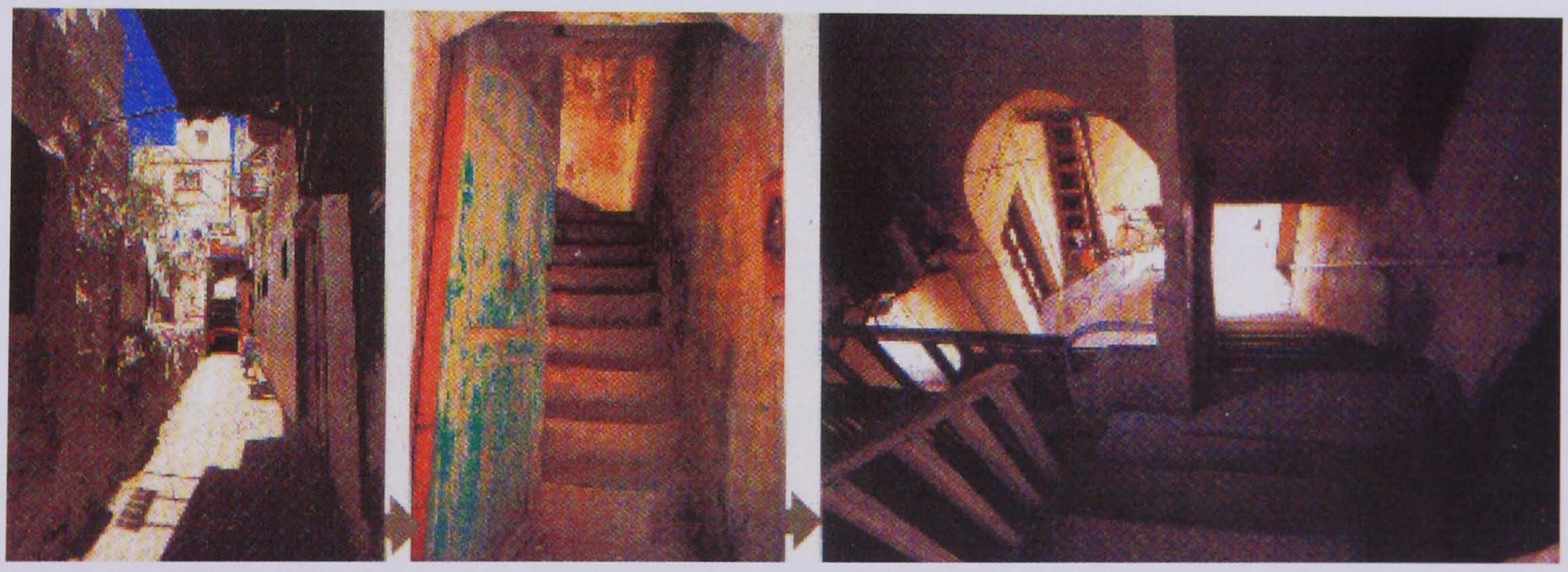
Partial map of the inner city of Sidon



Source: FNP, 2001, p.61.

Figure 4.20

Narrow streets in the inner city of Sidon



Source: FNP, 2001, p.61;

Figure 4.21 shows the internal courts. This introverted arrangement of residences was probably due to socio-cultural and traditional factors, as well as for climatic conditions (FNP, 2001).

Figure 4.21

Internal private and public courtyards

Source: FNP, 2001, p.61

4.2.4.2. Modern and Contemporary Urban Settlements

In the beginnings of the twentieth century piped water was introduced into the houses with the definitive installation of bathrooms and kitchens inside the houses. The number of floors was increased to reach in some cases four floors the limit until the introduction of lifts and reinforced concrete frame constructions, later around the middle of the twentieth century. With the appearance in Lebanon of excavation machinery more than one basement floors started appearing. Staircases, kitchen and bathrooms became part of the house, however until political independence and the end of World War II, the central plan remained in use with some articulations, such as the introduction of a buffer zone between kitchen and dinning room (Raguette, 1980). "The slow disintegration of the tightly knit family unit into a group of individuals, the increasing preference of privacy as opposed to togetherness made finally discard the central hall scheme"(Raguette, 1980; p.190).

The rapid development of the LCZ during the last twenty years owed mainly to the war, the unplanned urban development, and population growth and its concentration along the LCZ. This has been accompanied by active building construction, which, neglected possible impacts on the environment. This was also due to the fact that Lebanon was unprepared neither administratively nor professionally for the post-war reconstruction boom and added to this is the entrepreneurial mentality of the Lebanese that gives importance to quick gain above all other possible considerations, including cultural values (Saab, 2004).

With the introduction of contemporary building methods and materials the emphasis on construction and landscape has been lost. The construction of building with several levels and several flats per floor was introduced. The buildings are poorly planned with no regard to environmental factors (geography, topography, climatic and sensory factors). The same typology is repeated in the main cities, in the towns, and in the mountains erasing the limits between rural and urban, between centre and periphery. The landscape is fast disappearing due to the encroachment of buildings, with it the quality of air that is also decreasing.

Figure 4.22

New buildings encroaching on the landscape and traditional houses

Source: El Asmar (November 2004)

These transformations are clearly shown in figure 4.22, where high-rise buildings are encroaching on the mountains and overwhelming the remaining traditional "central houses". In addition the use of reinforced concrete is evident in contrast with the traditional use of in-situ stones. The introduction of reinforced concrete frames and concrete masonry units' enclosures (of a maximum of 20 cm thickness of a wall) with no insulation decreased the thermal values of the wall increasing the consumption of energy for heating and cooling, and increasing therefore pollution and energy consumption. The height of the apartments was reduced from around 4.50m in the traditional buildings to a maximum of 3.20m following the new rules and regulation. This decrease in height is beneficial during winter and in relation to energy consumption for heating. However it is negative in summer and necessitates mechanical mean for cooling, such as air conditioning.

The openings do not consider anymore illumination and ventilation, and the building is oriented haphazardly. Un-insulated flat roofs are commonly built along the LCZ, and pitched roofs are built only where it is required by the building code, relating the required percentage and grade of pitched tiled brick roofs and percentage of stone facing to aesthetic purpose and with no consideration for climatic issues. The top floors are usually very hot in summer and very cold in winter.

From a technological point of view the introduction of piped installation and sewage system was a positive novelty in building construction. In the absence of waste water treatment in all areas and sewage networks the building rules and regulations forces the building of appropriate sceptic tanks. In many expansion areas this is not done and instead deep pits reaching the water table are dug resulting therefore in the pollution of underground drinking water (Republic of Lebanon, 1997).

The lack of vegetation in the modern urban and rural settlements of cities and towns along the LCZ raises the summer air temperature from 2°F to 8°F, this phenomenon is known as the 'urban heat island effect'. The presence of shading trees and other vegetation in urban areas allows solar radiation and

cooling through evaporation of water from the surfaces of leaves and the soil. Roof, paving and streets asphalt, in addition to the lack of trees and green horizontal surfaces exacerbated by lack of evaporation, have low reflectivity and high absorption of heat by radiation, raising both surface temperature and air temperature to uncomfortable levels. This increases the demand for energy needed for cooling buildings in summer months (Estes et al., 1999; Moore, 1993).

4.3. Conclusion

In this chapter the current state of the built environment along the LCZ was discussed. The literature reviewed and the analysis conducted on-site, revealed the seriousness of the level of deterioration in the environment, and the extent to which the built environment has had an impact on the natural environment. The traditional architectural typologies and technologies that were directly based on social, economic, and climatic factors were analysed in comparison to contemporary buildings. The analysis revealed the patterns of unsustainable construction and urban development in contemporary settlements compared to previous development. Liger-Belair (2000) describes the transformation in these words: “We find a time of great upheaval brought about by new influences and the technological, economic, social, and cultural factors that have come from the West in the guise of modernity and from the East in the guise of Arab identity and these are further compounded by their Lebanese interpretation. The tradition completely disintegrates, and the territory the landscape, and the climate that had until very recently guided the course of building and generated the architectural heritage are forgotten, and dwelling loses its identity” (p.168).

The complete break of the built environment from the traditional dwelling could have been due to multiple factors:

- The loss of traditional techniques such as cutting and stacking stone, and the advent of new building materials and building systems, which allowed quicker and more flexible constructions.

- The pressing need for more dwelling units due to both migration before the civil war and displacement forced by the civil war is also a reason behind this change. This is compounded by the limited dimensions of the Lebanese territory and by its steep morphology.

- The transformation of rural areas from agricultural to commercial and industrial type of activity changed people's life and social activity increasing the distance of people from the interest in land.

- Liger-Belair (2000), considers the impact on Architecture of Lebanese Architects and Engineers that studied abroad in Europe, Canada, and USA, bringing back new tendencies. "The new trends, construction technologies and project management techniques ... further destabilized the already complex mix of lost tradition, professional archaism, and countless imported modernity" (Liger-Belair, 2000, p.177).

In order to facilitate recommendations and guidelines for the sustainable rehabilitation of existing buildings it is necessary to conduct case studies. An in depth quantitative and qualitative analysis focusing on one area, will show the rate of urban growth and its impact on the biophysical environment. The study will focus on the area of Zouk Mosbeh. However this does not limit the findings given that other areas of the coastal zone exhibit similar characteristics as ZM.

Zouk Mosbeh is on the fringe of greater Beirut, and has been haphazardly developed during the last twenty years with no respect for existing rules and regulations. The area is suffering from chaotic and dense residential development. The mixed land use and the proximity of incompatible typologies (industrial and residential) add to the problem. Sewage infrastructure and systems are absent, leading to the pollution of drinking water. Similarly energy consumption is also very high, which is met from conventional energy sources. As the use of air conditions and electric heating for enhanced thermal comfort increases energy.

Zouk Mosbeh offers a double challenge; which are constraints imposed by water as a coastal area and with a major natural feature the Nahr al Kalb River and Valley. Thus the challenge is how to achieve environmental sustainability in a coastal area like ZM given the above constraints.

CHAPTER 5

THE CASE STUDY: ZOUK MOSBEH (ZM)

5.1 Introduction

This chapter critically analyses the state of the built environment in the area of Zouk Mosbeh (ZM), the case study, and its impact on the natural environment and its inhabitants. The study of the geographical location of ZM will clearly help to define the physical boundaries of the area, as well as its importance in relation to the location on the northern edge of greater Beirut. This is also the case with the diversity of land-use, as well as its richness with respect to natural features and cultural heritage.

The history of the area's growth and dynamic development are looked at in the third section of this chapter. This approach is necessary in order to be able to analyse the impact of the unprecedented growth on the natural environment, especially on how the transformation of a small rural town into an urbanized area occurred (Appendix 2; Saber 1995, 2003, 2005). The comparison of the growth pattern that took place in ZM, which is also representative of all the rural areas along the LCZ, with acknowledged patterns in urban planning literature, will help in categorizing the current patterns, hence formulating appropriate strategies for the rehabilitation of ZM.

The impact of the built environment over the natural environment is critically analyzed in the fourth section, looking at the negative and unsustainable local patterns of commercial, industrial, and residential developments.

All of this is done relying mainly on primary data through site observation and note taking, and on secondary data including historical aerial photographs.

5.2 Geographical overview

Zouk Mosbeh is located in the region of Kesrwan on the northern border of "Greater Beirut", and along the Lebanese coastal line. "Greater Beirut" is an encompassing definition which relates to the 1964 development plan that shows the administrative area of Beirut. ZM is 200 m above sea level and has a surface of about 4,258,499 m^2.

Figure 5.1

Zouk Mosbeh Map

Source: adapted from the Lebanese Army Directorate of Geography (scale 1/20.000)

Figure 5.1 shows that, to the west ZM is bounded by the Mediterranean Sea, to the south by the valley and the big river "Nahr el Kaleb", to the east Jeita and by a valley in the North (fig. 5.1).

The "Nahr el Kaleb" ravine is representative of recurring landscape type[i] along the Lebanese coast, where river flows have carved out deep gorges interrupting the linear and regular coastal plain. These ravines are not only topographic exceptions but they benefit from erosion and climatic sheltering; they contain richer soil, more moisture, and therefore a higher level of floral biodiversity.

Figure 5.2

Nahr el Kaleb River and Valley

Source: Saber, 1995 (a), p.15

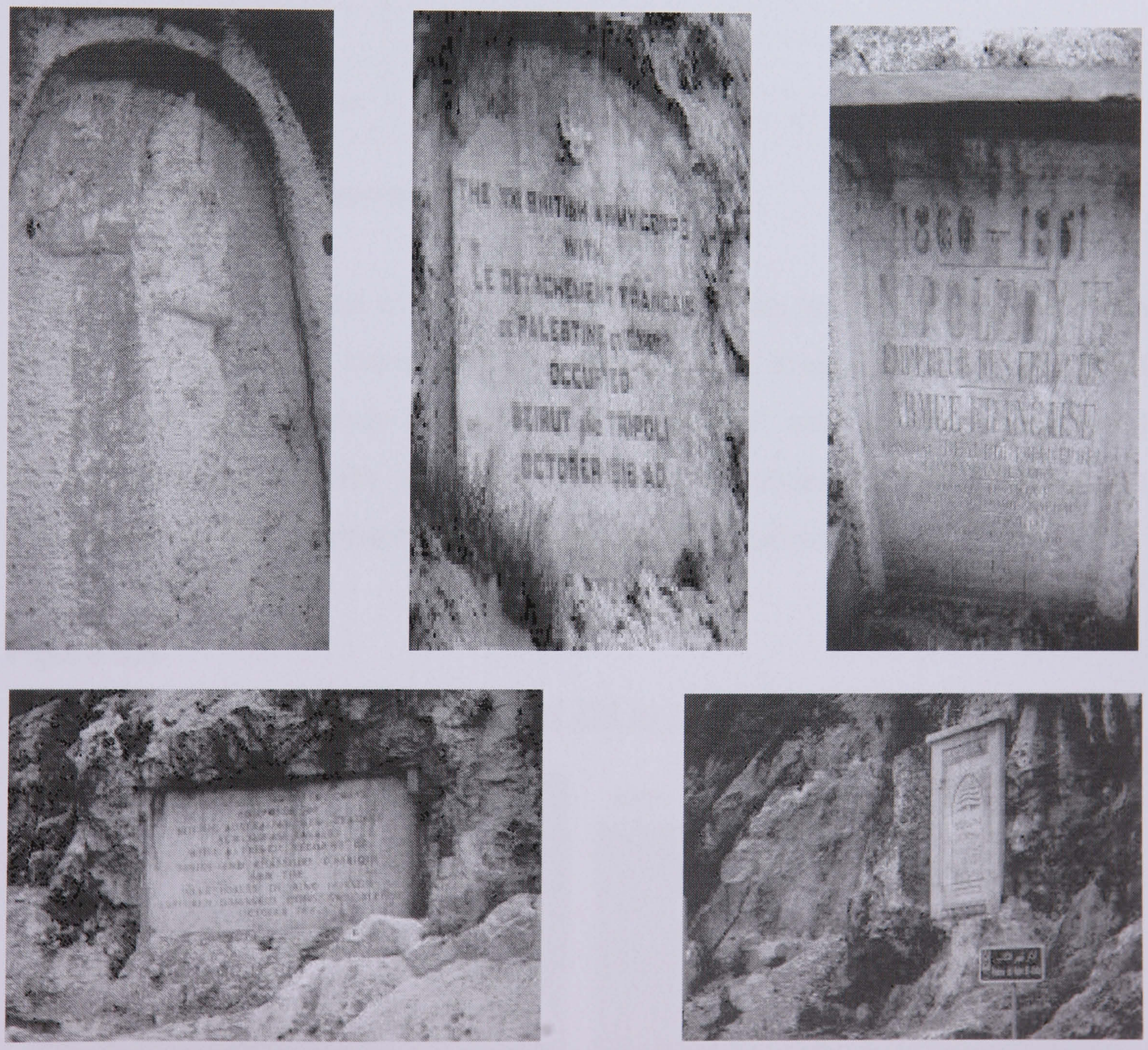
The valley of "Nahr el Kaleb", as figure 5.2 shows, remains one of the few areas that have escaped the rampant coastal expansion, and this was probably due to its rugged terrain. The agriculture of the foothill is of peri-urban nature, and is surrounded by steep slopes reaching an altitude of 100m above sea level. It is worth mentioning that the "Nahr el Kaleb" river is historically important for the

numerous 'stelae' (22 stelae) carved on its rocky walls marking the passage of conquerors from the 2nd millennium BC among which, Egyptians, Assyrians, Neo-Babylonians to the late withdrawal of the Israeli Army from the South of Lebanon in year 2000, unfolding therefore the history of ancient and modern Lebanon.

Figure 5.3 shows some of the stelae representing from left to right, Nabukhaz Nassar, the British Army in 1818, Napoleon's army in 1860, the French army in 1918, and again the French army in 1946.

Figure 5.3

Stelaes on the Rocks of Nahr el Kaleb

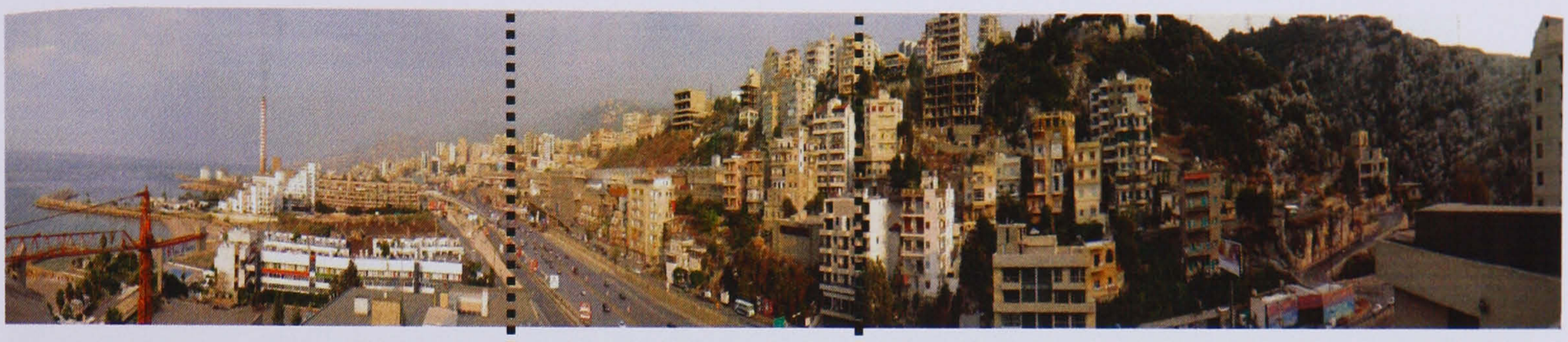


Source: El Asmar, November 2000

Figure 5.4 is a panoramic transversal view taken from the southern part of ZM towards the north of Lebanon and across the area of ZM, shows the peculiar characteristics of the area and a brief description based on field notes of the impact of the built environment on the natural environment. Accordingly, ZM could be divided into three different zones as shown in Figure 5.4 in

Figure 5.4

Panoramic View across ZM Area



1. Sea –bound (Al Wata)	2. Highway	3. Foothill	Zone
Industrial &Tourism	Commerce, residence & Industrial	Industrial & Residential	**Land use**
Irregular Tourist Compounds	Ribbon Development	Mixed Land Use & Urban Encroachment	**Problems In the Built Environment**

Source: El Asmar (November 2004)

1. The Sea-bound plain is called Al Wata which was famous for agriculture in the 70's before it was transformed into a region of irregularly built sea tourist resorts. The area extends from the "Nahr el Kaleb" estuary to the south and Zouk Mikael to the north. In Figure 5.5 it can be observed that, summer sea resorts are rapidly encroaching on the narrow agricultural land.

Figure 5.5

Sea-bound Plain of ZM in 1958 and 2001

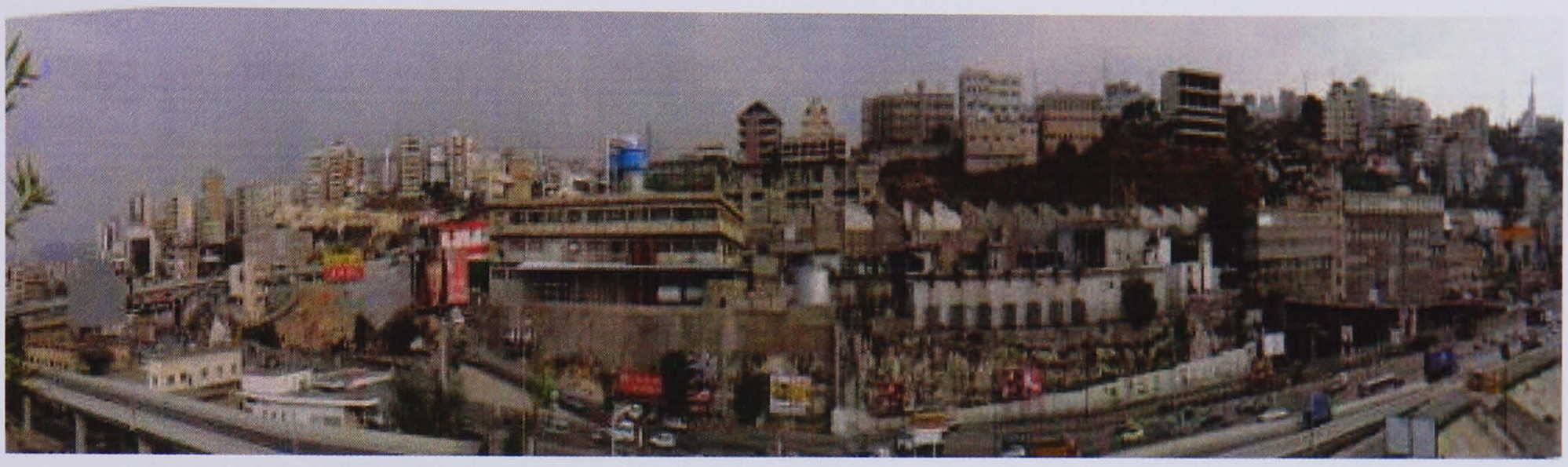
Source: LBCI 2001

Source: ZM Municipality 2001

2. Along the Highway, land use is characterized as a mixed used area of industrial and residential development. This urban sprawl is typical of the extended metropolitan areas along the Lebanese coastal line. Figure 5.6 clearly shows the western industrial area of Adonis in ZM, behind which is part of the residential area.

Figure 5.6

ZM Industrial Area along the Highway



Source: El Asmar, March 2003

3. The foothill above the highway is characterized by two industrial zones (fig. 5.6) in proximity of the old ZM town and the residential Adonis area, in addition to three schools among which two are public, and a private university campus.

5.3 Models and theories of urban growth

Eisner et al. (1993; p.51) distinguish between different types of urban communities based on their social and economic structure, the 'crossroad community' whose dimensions are variables depending on the movement of traders. These communities are generally located at transportation terminals such as river or seaport, the 'primary agricultural community', the service area for rural communities, the 'commercial city', the 'industrial city', the 'transportation city', the 'recreational city', the 'educational city', the 'mining community', the 'retirement community', and governmental centres.

There are also cities that include all or part of the above functions. All of these types of communities in the modern world exist within systems organized into hierarchies. This geographic phenomenon is explained by the central place

theory which attempts to illustrate how settlements locate in relation to one another (Cronon, 1991). Central place theory (CPT) was originally developed by the German geographer Walter Christaller in 1933, while studying how urban settlements in southern Germany have developed in size and space in relation to each others. Three basic concepts underpinned his study: centrality, threshold and range (Brush, 1966, Agarwal, 2001).

- Centrality considered the importance of a place in the region and around it.

- Threshold being the minimum market needed to bring about the selling of a particular good or service.

- Range is the maximum distance consumers are prepared to travel to acquire goods.

Agarwal (2001) argues that "despite the inapplicability of the model in realistic situations, CPT was a breakthrough in predicting and understanding the hierarchical development of settlements, where each level of the hierarchy provides different and distinctive services.

The patterns of urban growth of the different types of communities have also been the subject of studies by sociologists, economists and geographers. Several models where developed explaining where different types of people and businesses tend to exist within the urban setting. Three classic models based on urban ecology are generally considered in the studies of urban growth; the concentric zone model, the sector zone model, and the multiple nuclei model (Legates and Phillips, 1981). The three models were based on data gathered in at least one city or more and the trends they have formed;

1. Concentric zone model: developed in the 1920's by the sociologist Ernest Burgess in observing American cities, particularly Chicago's internal urban structure. Following the great fire of 1871, Chicago experienced huge population growth which has rapidly increased from 10.000 in 1860 to

exceed two million by 1910. This was due to the influx of immigrants and produced homelessness, poor housing and bad working conditions. The way the Chicago neighbourhood grew and the pattern it followed was assumed by Burgess as following similar patterns of growth of animal and plant communities. McKenzie (1971), in looking metaphorically for a relationship of human ecology to plant and animal ecology defines human ecology "as the study of the spatial and temporal relations of human beings as affected by the selective, distributive, and accommodative forces of the environment" treated the city as a plant biome (p.18).

Based upon this theoretical framework of urban ecology Burgess developed the concentric zone model. According to this model the city grows outwards in concentric rings starting from the centre, zone 1, in the Central Business District (CBD), where most of the tertiary employment is located and where the urban transport infrastructure converges. Figure 5.7 shows the five rings each representing a land use type.

Urban Growth Models

Figure 5.7

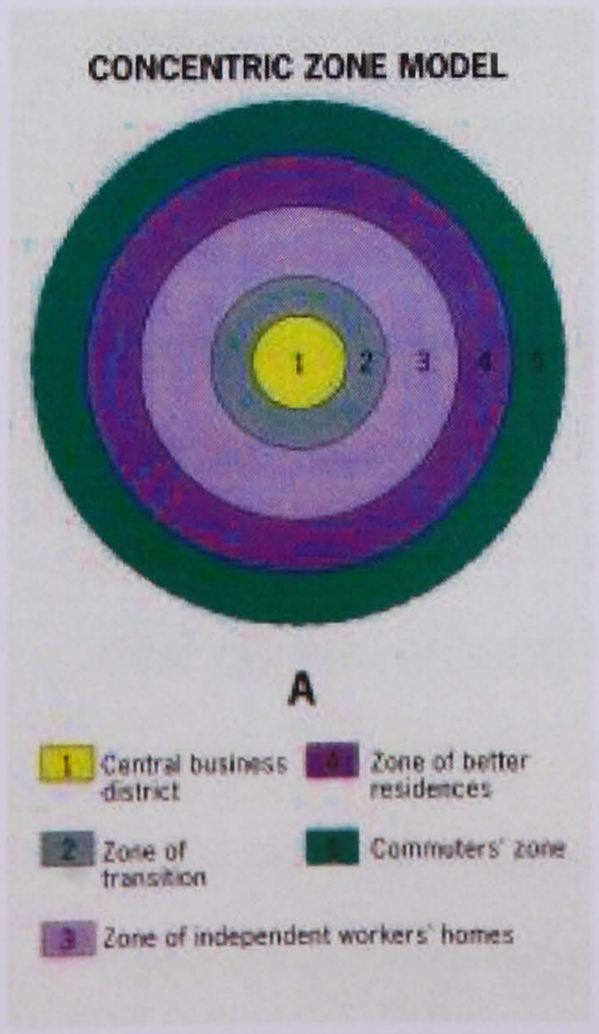


Figure 5.8

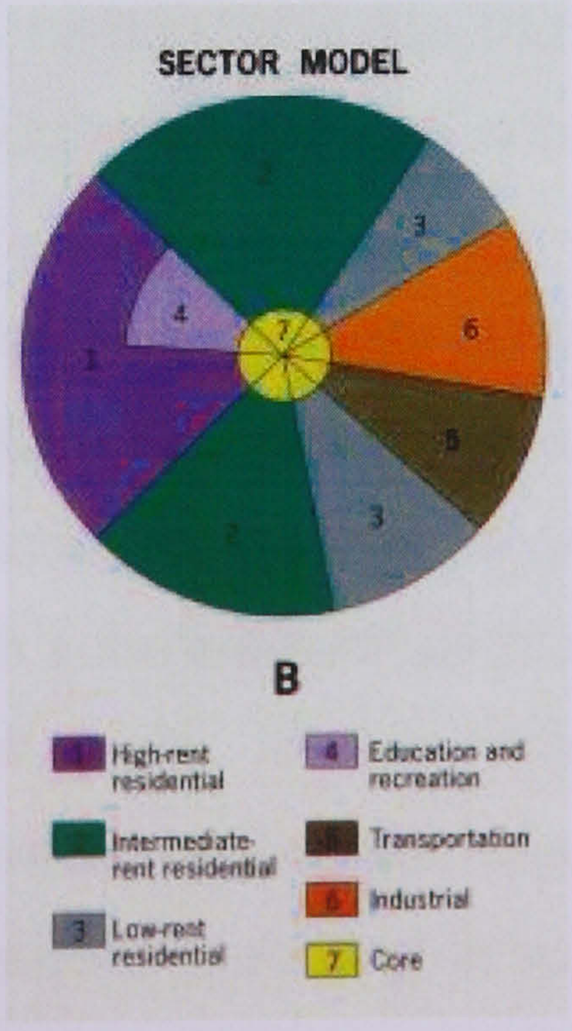
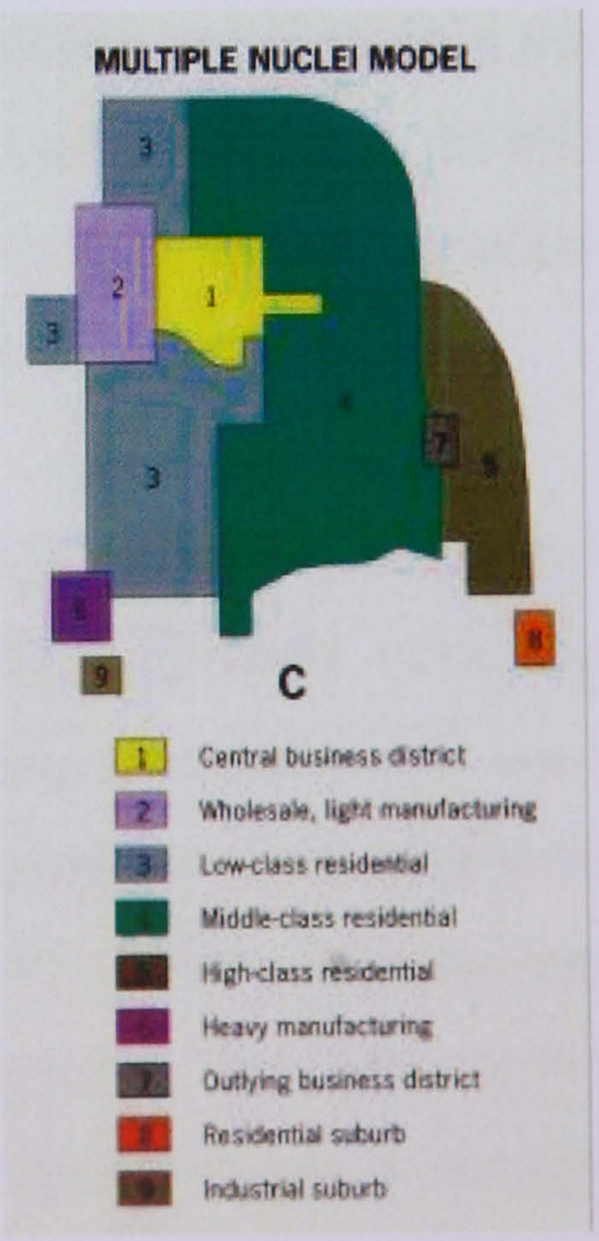


Figure 5.9



Source: http://piru.alexandria.uscb.edu/collections/sweeney/urban_geography/Centralplacetheory.ppt
Retrieved: August 24th, 2006.

Zone 2 is the area of transition. Legates and Phillips (1981) in referring to Burgess, explain this area as district of residential deterioration where business encroaches on industry from zone 1, and includes rooming houses, slums, and artists' colonies. Zone 3 is the area of independent worker's home including duplexes or two-family houses where immigrants and their second generation families live. Zone 4 is the area of better residences including houses for small businessman, professional people such as clerks and salesmen. Zone 5 is the 'commuter's zone', or the suburbs. It is where people working in the centre choose to live. It consists mainly of higher quality housing.

2. Sector Zone Model: Soon after Burgess in the 1930's, Homer Hoyt, a land economist, in looking for the dynamics of residential change developed the sector zone model (Figure 5.8) based upon his survey of 142 cities. Hoyt mapped these cities according to eight criteria; rent, ownership, private bathroom, and age of building, annual repairs, central heating, overcrowding, and race (Caucasian / African American residences). According to this model, the city develops in a series of sectors, not rings, certain areas being more attractive and suitable for different activities. In the centre is the core, the CBD, and as cities grows, activities expands from the centre, particularly along transportation networks (roads, railroads). In this model if an area has a certain land use then this sector would continue having that function through time (Legates and Phillips, 1981).

3. Multiple nuclei model was developed by geographers Harris Chauncy and Ullman Edward in 1940's (Figure 5.9). This model originated from the previous two models. According to this model, a city includes more than one centre around which activities such as ports, neighbourhood, business centre, university, airport, parks, revolve. Harris and Ullman still saw the CBD as the major centre of commerce; they suggested that specialized cells of activity would develop according to specific requirements of certain activities, different rent-paying abilities, and the tendency for some kinds of economic activity to cluster together. An airport might attract hotels and

warehouses, while a university may attract well-educated residents, bookstores, and copy places. The CBD at the centre would include light manufacturing and wholesaling located along transport roads. Heavy industry would be located at the outer edge of the city surrounded by low-income housing, and suburbs of commuters and service centres would occupy the urban periphery (Legates and Phillips, 1981).

5.4 History[8] and dynamic growth of Zouk Mosbeh

ZM witnessed rapid physical developments since the 1950's to the present. It has evolved from a mainly rural and industrial town into a thriving mixed-used urban city of residential, industrial, commercial, cultural, tourist and religious areas. This development heightened in mid 70's and has maintained an upward trend until presently. This is clearly evident in Appendix 2.

In the beginning of the 17th century to the middle of the 18th century the backbone of Mount Lebanon's economy was the silk industry and agriculture respectively. ZM was at this period a relatively developed and wealthy town owing to its large agricultural land as well as its proximity to the coast and Beirut respectively. This prosperity was brought to an abrupt end by the imposition of taxation on trade, which resulted in 1820 in a civil-riot. The emigration of the local population to nearby districts and towns, or abroad, and years later the devastating effect of the first world war, added to the already existing problems of the area and by that time, two-third of the remaining ZM inhabitants had died from sickness and hunger. This lead to the rapid demise of ZM which around the mid. of the 20th century became a small and poor village deprived of infrastructures such as electricity, water, telephone, medical assistance as well as a network of roads. A census made by the diaconate[9] of Damascus in 1932 counted 104 houses in ZM and a number of population reaching approximately 550, among which 270 males and 280 females.

The end of the French mandate in Lebanon in 1946, and the 1943 political independence paved the way for a new era of development in Lebanon. In mid

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[8] Saber Anwar, 1995, 2003, 2005.

[9] Diaconate: the office or period of office of a deacon or a subordinate officer in a Catholic Christian church

1950s water was introduced to the area of ZM by the development of a water network from Nabeh el Assal springing from the mountains (between 2250 and 3000 m altitude from the sea level) in the east of Eyoun el Simane, in the same district of Kesrwan and melds into Nahr el Kaleb.

In 1954, the first municipal committee of ZM was formed, and one of the first policies introduced was the imposition of taxation, which served amongst other things, as an effective urban management tool. A list of taxes was forced and included taxes for residences, industries, artisans, commerce, billboards and signs, and telephone machines.

In 1955 the Lebanese electric power plant (EDL) was built in the area of Zouk Mikael, along the coastal line, and therefore the electric grid was installed to reach ZM and its neighbouring towns and villages. In the same year a municipal infirmary was organized, and basic infrastructure started to appear. In addition to tax revenue, community efforts especially those of the wealthy inhabitants were mobilised, which may explain the rapid development of ZM.

Progress was so rapid that in 1956 the municipal committee met to dedicate an area of ZM for industrial development, in line with the request by the Higher Council of Town Planning[10] to define industrial areas to be included in the general zoning plan of the Lebanese territory.

In 1959 a main road network connecting Nahr El Kaleb to Jeita passing through ZM was implemented. This road was executed to enable visitors to reach the Jeita Grottos, a 600m subterranean lake and caverns.

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10 "In 1963 the first town planning legislation applicable to all of Lebanon was adopted. According to this legislation, all matters related to town planning were to be concentrated in one single authority: The Directorate-General of Town Planning, assisted by the higher council for town and country planning. (Saade, 2002)

Figure 5.10

Advertisement for the New "Adonis" Residential Area

Source: Saber, 2003 p.364, 365

During the same year 1959, the "Adonis new residential zone" project in the area of ZM started, and this project was enhanced by the inauguration of the Beirut-Tripoli main highway which was only 300m distant. This project was initiated by a company called SLAF, which started opening roads in the hill of Adonis and introducing electricity. The project aimed at transforming this area into a medium to high income residential housing, comprising low-rise buildings and villas. Figure 5.10 is the advertisement of the SLAF real estate company related to the residential area of Adonis.

The first town planning legislation applicable for all Lebanon was approved in 1962, and in 1963 the Directorate General of Urbanism (DGU) was created together with the Higher Council for Town and Country Planning, and to the Green Plan project. A commission appointed and assisted by Ecochard prepared and submitted an official Greater Beirut (Beirut and its outskirts) Master Plan (commonly referred to as "the plan Ecochard"). This plan was approved without modifications. It consisted of functional zoning including industrial zones and public utilities and controlling suburban densities, and frozen coastal development non aedificandi (CDR 1997, Salam 1972, Salam 1998, Fawaz, 1993). In 1964 Adonis hill included an industrial zone in proximity

to the residential zone. Following the advertisement of the Adonis project people started to be attracted to the Adonis area of ZM.

With the beginning of the civil-war in 1975, people, fleeing from Beirut front lines and North Lebanon, found refuge in ZM and neighbouring areas, increasing therefore the rate of development and growth. This situation has continued in to the present time transforming the previously rural area into an urbanized one. However this growth and development was very quick and sudden, it was also unplanned. The negative impact of this course of development of ZM's built environment on the natural, social as well as aesthetic environment is of huge importance. Saber (2003) considers this growth positive for the local economy. However it is clear from his analysis that the possible negative impact on the natural environment, the traditional features and cultural values of the town were not considered.

Figure 5.11 depicts the current land use pattern of ZM. If compared with the three classical models previously described, we can see that the current pattern in ZM reflects mainly the characteristics of the multiple nuclei model developed by the two geographers Harris and Ullman in the 1940's, whereby specialized nuclei cluster together in correspondence with the roads network and the proximity and compatibility between activities (Legates and Phillips, 1981). Along the highway and towards its western side along the Mediterranean Sea, tourist summer resorts have mainly developed. On both sides of the coastal highway commercial and residential medium rise buildings have developed and in addition to some industrial areas.

The land use of the areas on both sides of the Nahr el Kalb River is agricultural. Leisure facilities such as Water Park, specially equipped kids playground, and dogs training facilities have also clustered the lower edge of the hill in the proximity of the river. On the top of the hill and simply reachable from a primary road cutting through ZM and linking it with the east and the old core of the ZM town are located a school and a university, belonging to the near monastery (religious area) of the Mariamite Maronite Order. Just to the other side of the

same primary road is located the old ZM and from there towards both the east and the west the rest of the expansion areas of ZM.

Figure 5.11

Current Land-Use Map of Zouk Mosbeh

Source: Lebanese Army Directorate of Geography (scale 1.20000)

5.5 Impact of the Built Environment on the Natural Environment of ZM

The previous section looked at the historical development and growth of ZM. An analysis of this growth reveals the serious impact of the built environment on the natural environment, which has manifested in huge deforestation and the conversion of agricultural land for construction purposes. This section is devoted to the existing infrastructure, which has proved inadequate because of the rapid rates of urbanization, especially the sewage network, which has

almost collapsed, and at most replaced by deep pits disposing domestic and industrial waste and water contaminating the water table. This has exacerbated the environmental problems of the area which have manifested in different forms such as aesthetic, acoustic, and solid wastes pollutions. This is further compounded by the close proximity of the residential and industrial areas.

The residential zone consists of Adonis and the historical centre of ZM and their expansions. The Adonis hill reaches the altitude of 100m above the sea level, while the historical centre of ZM reaches the altitude of 200m. The area of Adonis consists of approximately 600 plots of ranging between 700 to 1000 m^2. The plan which considered the area for low rise building was not respected, resulting in its current status as an overcrowded area of medium rise buildings[11] (Appendix 2). This transformation of forests into residential low and medium-rise buildings produced a two fold impact on the natural environment. The proximity of both the industrial area to the south, and the electric power plant to the north-west of ZM have a serious and dangerous impact on the wellbeing of the inhabitants of Adonis and its expansion areas as well as on the ZM historic centre and its expansion areas. The negative impacts in ZM are manifested in the forms of:

- Air pollution
- Acoustic pollution
- Water pollution
- Solid waste
- Soil pollution
- Aesthetic pollution

Air pollution in ZM is caused by many factors; including industrial pollution, construction sites, and vehicular traffic (Republic of Lebanon 2001, Dilweg 1998). This vehicular traffic which was monitored for the Greater Beirut Areas, recorded peak hours volumes of 221,409 daily traffic volume in correspondence with the area of ZM (Republic of Lebanon 2001).

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[11] The categories of buildings (i.e. low rise, medium rise, etc.) are described in chapter 7 of the physical data analysis.

The power plant of Zouk Mikael in proximity to ZM area consists of five power generation lines. Each line includes a steam boiler to produce high-pressure and a steam turbine or generator based on diesel fuel. The installation is maintained at a basic level and maintenance is reactive in case of accidents. In addition, water for the boilers is made in a desalination plant. The brine is returned to the sea, with no treatment. Finally the inappropriate placement of oil storages on non impervious platforms, allows spills to easily penetrate into the soil, reaching the sea (Republic of Lebanon 2001, Dilweg, 1998). The prevailing south western wind carries the smoke from the stacks of the power plant increasing the air pollution of ZM area. Figure 5.12 from Adonis, shows the proximity of the power plant to the residential areas of Zouk Mosbeh.

Figure 5.12

Adonis Area and Smokes from the Power Plant

Source: El Asmar (July 2006)

Table 5.1 summarizes the forms of air pollution in ZM as well as the negative impact of air pollution on the inhabitants' health and wellbeing.

Table 5.1

Forms of Air Pollution in ZM

Air pollution		Emission	Impact on health, wellbeing and on the environment
Industries, and construction sites	**Wood**	Dust, and wood fibres	• The continuous breathing of dusts, particulate and fibbers causes serious problems and diseases in the lungs, among which; pneumoconiosis, fibrosis, silicoses, etc. • Long exposure to hydrofluoric acid will result in accumulation of fluor in the body, leading to turbulence of calcium, resulting in bones disease called fluorose. • Vaporization of Polychlorinated biphenyl (PCBs) from paint results in the appearance of skin disorder (acne-like), a burning sensation in the eyes, nose and throat, in additional to other effects. • Lead, once inhaled, interferes with the blood-cell formation, resulting in anaemia, and also could cause kidney damage, sterility, miscarriage, and birth defects. • Mercury evaporation from paints during the drying process; enters the human body and attacks liver and kidneys. • CO2, CO emission causes diseases such as asthma and suffocation. • Annual decrease of vegetation in ZM; i.e. crops of olives, grapes and almonds. According to the inhabitants, flowers, and other household plants suffer from poor growth. • Buildings' limestone is soiled and deteriorated, subjecting the surfaces to chemical attack by acid gases. • Deterioration of concrete masonry blocks, plaster, and mortar joints are also caused by the effect of sulphates in contact with water. • SO2 deteriorates, leather, paper and paint, and glass destroying their composition.
	Stones	Dust, particulates of CaO, SiO2, Fe2O3, Al2O3, as well as asbestos	
	Materials for cleaning, cosmetics and perfumes	Odours, particulate, SO, CO, NOx, etc.	
	Aluminium products	Heat, caustic soda vapour, CO2, CO, SO2, NOx, metals vapour, etc.	
	Paints	Mercury, acrolein, lead, polyester, asbestos, polyvinyl acetate, CO2, particulate, etc.	
	Textiles	Asbestos, polyurethane, acetic acid, ammonia, chlorine, etc.	
	Plastics and derivatives	Heat, odours, blue haze, asbestos fibbers, CFC13	
	Food and pharmaceutical products	Airborne biological agents, odours, dust, VOC	
	Construction and pieces metals	Dust of cock, CO, CO2, NOx, SO2, dust of lead, graphite dust, SiO dust, metal vapour	
	Vehicles' reparation	SO2, NOx, CO2, CO	
Vehicular traffic		NOx, SO2, CO, CO2	
Power plant		NOx, CO, VOC, particulate, SO2, SO3, Na3PO4. Spills of oil into the soil, and to the sea.	

Source: Adapted from Godish (1997), Boubel et al. (1994), Mavis (1998), Dilweg (1998), Nadakavukaren (2000), and Republic of Lebanon (2001)

Acoustic pollution in ZM is manifested in the form of continuous noise generated from: Construction sites, diesel fuel generators used to overcome irregular electric supply, Traffic, and industrial noise. Nadakavukaren (2000), considers acoustics pollution "high level of noises associated with machinery, equipment, and general work practices" (p. 507), and that the main negative impacts associating with acoustic pollution include the loss of hearing, excessive stress leading to a variety of diseases: i.e. heart diseases, high blood pressure, ulcers, headaches, in addition reduced learning ability and work performance, and sleep disruption are also caused by noise (Bowling and

Edelmann, 1987). Furthermore, the continuous vibration due to noise deteriorates buildings and building materials through time (Nadakavukaren, 2000).

Water pollution in ZM is mainly caused by Industrial and domestic disposal of waste water into the water table and directly to the sea. Table 5.2 summarizes the possible forms of water pollution generated from industries and construction sites in ZM as well as the type of effluents disposed either in the water table or in the sea.

Table 5.2

Forms of Water Pollution in ZM

Water Pollution		Effluents
Industries, and construction sites	**Food Products**	Water from wash and rinse process, unrecovered by-products, and spoiled or damaged products, containing high BOD5[12], COD[13], oil and grease, coliform bacteria, suspended and dissolved solids. In addition to some contaminants as pesticide residues, complex oils, alkaline or acidic compounds, etc. may be present in wastewater effluents.
	Stones, Asbestos pipes & corrugated cement sheets	Water used for cooling and cleaning during the process of cutting, smoothing and polishing. This water will carry away pollutants such as suspended solids. In addition to grease, oil and metals (iron, manganese, and zinc).
	Materials for cleaning, cosmetics and perfumes	• From the production of soap: caustic soda, carboxilate of sodium, oil and grease, heavy metals, suspended solids, phenols and pesticides. • From the production of cosmetics: caustic soda, sodium tripolyphosphate, anionic surfactant, heavy metals, suspended solids, phenols and pesticides, oil and grease.
	Aluminium products	The processing generates: Al2O3[14], caustic soda, aluminium hydrate, cyanide from the electrolyzing process of Aluminium metal, fluoride, silicon, sulphur, iron, oils, metals, chromate, etc.
	Paints	Solids, fibber, and filler
	Textiles	Water used for bleaching, washing of untreated fabrics or printing machines, release colorants, oil and grease, heavy metals such as chrome, cobalt, copper, lead, mercury, nickel and Zink. In addition to suspended solids.
	Plastics and derivatives	Suspended polymers, additives, and particulate
	Paints and plastering	Solids and fibbers
	Construction and pieces metals	Water used for the cooling of the cover of the furnace and for the cleaning following moulding process. In addition to toxic solvents used for metal cleaning.
	Paper products	Titanium oxide, polyester, organic pigments, H2S, acrylic composition, etc.

Source: Adapted from Laws (1993), Inmuong (1998), Nadakavukaren (2000), and Republic of Lebanon (2001)

In addition to industrial water pollution, is the domestic waste water. Along the main streets of ZM there already exists a network for sewage canalization.

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[12] BOD or Biochemical Oxygen Demand is the amount of oxygen required by micro-organisms to decompose the organic substances in sewage. It is among the most important parameters for design and operation of sewage treatment plants (Laws, 1993, Inmuong, 1998, Nadakavukaren (2000).

[13] COD or Chemical Oxygen Demand is a test that is commonly used to indirectly measure the amount of organic compounds in water. In other words it is able to determine the amount of organic pollutants found in surface water (Laws, 1993, Inmuong, 1998).

[14] Al2O3 is alumina produced by processing Bauxite in the production of Aluminum (Dilweg, 1998).

However this does not include the residential and industrial areas of Adonis. In addition this infrastructure is not in operation yet, especially that there is no waste water treatment infrastructure neither in ZM nor in the neighbouring areas. Instead of that, each building in ZM has either a septic tank, which is not appropriately built in all cases or with the pretext of asking for a permit to dig an artificial well to extract water, buildings waste water is disposed of directly in these wells, reaching and polluting the water table. It is worth notifying that the records of ZM municipality indicate 187 artificial wells distributed all over the area, while official statistics done in March 1996 show 440 artificial wells in the area of ZM (Republic of Lebanon 1997, and 2001).

In addition and due to the lack of appropriate infrastructures for the disposal of waste water, in many areas of ZM, small floods and runoff of wastewater appear in the streets, releasing awful odours and visual pollution and degradation (fig. 5.13).

Figure 5.13

Waste water runoff in Adonis

Source: El Asmar (July 2006)

Heavy metals, pathogenic organisms and other pollutants have contaminated the water of ZM from the previously mentioned effluents (table 5.2) these could have serious negative impacts on the health of the inhabitants. Due to these pathogenic organisms: diseases such as typhoid fever, bacterial dysentery,

cholera disease, poliovirus infection, and amoebic dysentery are prevalent (Abel, 1996, Fadel El et al., 2003).

Industrial and domestic solid wastes are among the major environmental problems of ZM. Both raw industrial and solid wastes are disposed without processing, leading to soil contamination. However, an attempt has been made to address this situation but whether this is sufficient is open to debate. "Sukleen", a Lebanese private company for waste collection and streets' sweeping, started operating in June 1994 covering the whole of greater Beirut and most of Mount Lebanon. The company was granted the ISO 9002:1994 in January 2002. In addition a recycling project was launched by "Sukleen" consisted in placing recycling bins for glass, tin and plastics, in different areas of greater Beirut. Sukleen's collections did not include industrial waste. This result in huge quantities of industrial wastes left around the industrial area, contaminating the soil, groundwater, and the air by releasing gases.

Figure 5.14 clearly shows a build-up of industrial solid waste. Particularly, the photograph on the right is a sign in Arabic warning against illegal disposal of solid waste, which has obviously been ignored by the deluge of deposited solid waste.

Figure 5.14

Industrial Solid Waste in ZM

Source: El Asmar (July 2006)

In addition some industries in ZM incinerate their wastes in open places adding to the problems of air pollution. The absence of appropriate dumping sites and

solid waste collection and separation points for recycling, in addition to the fact that inhabitants dispose their wastes randomly and improperly in waste bags exacerbates solid waste problems in ZM. Similarly figure 5.15 clearly indicates that the issue of solid waste is not restricted to the industrial sector but also a common problem in residential areas.

Figure 5.15

Domestic Solid Waste in ZM

Source: El Asmar (July 2006)

The chaotic urban expansion does not only impact on the environment but also have visual pollution impact, which is common along most of the LCZ. These include overhead power lines, motorway billboards, scarred landforms, open storage of municipal and industrial solid waste, and unfinished and deteriorated buildings. Indeed, Skaff (2001) who is the senior designer of the Grey Worldwide visual communication agencies for the Middle East and North African regions published a book which he entitled “the republic of concrete”. In his book panoramas of 5700 sad photographs were collected in more than 253 Lebanese cities and villages. He regarded these as “a slap” in the face of all that did not consider the magnitude of environmental disaster in Lebanon, and who did not perceive the extents of “disfiguration” of what was once the “most beautiful country of the Mediterranean basin”.

As figure 5.16 shows the effect of visual pollution along the LCZ highway is evident. The high-rise buildings along the western side of the highway, forming a ribbon development of tourist summer resorts, prevents the view of perhaps the most beautiful coastal lines of the world.

Figure 5.16

The Highway from South of ZM towards the North

Source: El Asmar, October 2002

When reaching ZM the industrial area is clearly evident. It is highly dense with buildings, hangars, open dumps of industrial wastes, and open industrial drains. The proximity of the industrial area to the residential area, the absence of green open spaces and vegetation along roads, and the predominant use of concrete and of a unique form of buildings with no respect to contextual constraints or to social or traditional typologies are clearly visible. Figure 5.17 clearly shows the overcrowded residential area of Adonis, and in the background the urban encroachment on natural environment is evident.

Figure 5.17

Adonis Residential Area

Source: El Asmar (October 2004)

In figure 5.18 the encroachment of new buildings on the traditional dwellings is evident. The contrast between concrete, with its huge amounts of embodied energy, is also clear in contrast with local stone.

Figure 5.18

Modern Buildings Encroaching on Traditional Houses in ZM

Source: El Asmar (November 2004)

5.6 Conclusion

The current state of Zouk Mosbeh, was described, and analysed. The geographical location of ZM along the LCZ was studied and its main natural and cultural values were clearly identified.

The historical and current land-use and physical development of ZM in relation to the political, economic, social, and environmental transformations were also considered in order to understand the dynamics of urban growth in the area. These dynamics were compared with the classic models of urban growth, the concentric zone model introduced by Burgess in the 1920's, the sector zone model introduced by Hoyt in the 1930's, and the nuclei zone model introduced by Harris and Ullman in 1940's. The comparison has shown the current development patterns of ZM.

ZM most probably follows the multiple nuclei model whereby specialised activities cluster together in correspondence with road networks. This has transformed the rural town into mixed land-use area enriched by the presence of tourist resorts, recreational and cultural facilities, as well as industrial activities. However, the analysis of such rapid urban development has revealed serious negative impact on the natural environment, and on the well being, and the health of the inhabitants. This pattern of growth is affecting ZM in different ways especially with regards to air pollution, water, soil, industrial and domestic waste, acoustic, and aesthetic. The effects of these forms of pollution on the natural environment and on people's health and well being were also identified. In order to devise appropriate guidelines for sustainable rehabilitation of the built environment in the area, it will be necessary to conduct an in-depth analysis

The gathering and analysis of primary data from the different parts of ZM will allow an in depth study of the current state of the built and natural environment of the area. This will also show the different problems existing with buildings requiring the analysis of the different building types in the area as well as the inhabitants and the government.

CHAPTER 6

RESEARCH METHODOLOGY

6.1 Introduction

This chapter considers the theoretical approaches to research methodology, in order to acknowledge the existing approaches and to build upon the methodology that will be used in this work. It reviews the different research models, particularly the conflicting and meeting thoughts, of positivist and interpretive world views; taking into consideration both quantitative and qualitative approaches to research methodologies. Triangulation and its relative assets in integrating both qualitative and quantitative research methodologies will be considered. The second part of this section identifies and describes the methodology used in this research and the reasons behind the choice of one methodology over the others.

6.2 Theoretical approaches to methodology

The literature related to research in general shows a dichotomy between two main models; the positivist model and the interpretive model (Neuman, 2000 Fellows, and Liu, 2003). This controversy was first debated by Charles Snow in his book in 1959 on the two cultures and the scientific revolution. Snow (1959; p.4) considers that the "intellectual life in the whole of the western society is increasingly being split into two polar groups... literary intellectuals at one pole and the scientists at the other, and the more representative, the physical scientists".

The scientific knowledge is interested in facts and, looks at the questions: how the world was made? And how human beings were made? The humanistic knowledge interested in values and, looks at the questions: what is the meaning of the world? And what is the meaning of our lives? (Snow, 1959)

6.2.1. Positivist model and quantitative research method

Positivist research model dates back to the 19th century and derives from the works of Auguste Comte (1798-1857). The approach was reconsidered by the British philosopher John Stuart Mill (1806-1873) who elaborated and modified its principles; furthermore Emile Durkheim (1858-1917), a French sociologist, developed this approach to become the model for positivist social researchers (Neuman, 2000). The positivist model is the most widely used approach and was originally developed for the study, of natural phenomena. It is based on the natural science, and recognizes only a single reality. In general it aims at discovering natural laws to enable people to predict and control events. It is based on quantitative method, and often uses experiments, surveys and statistics to test hypothesis.

Thus, the quantitative research methods attempt to verify theory and aims at producing universal truths and knowledge in a way that allows others to directly replicate it. This approach to research leads to continuous attention to topics able to produce quantifiable data, and in doing so excludes other data, where the objects of research are difficult to observe, in order to classify measure or delimitate measures. Among the quantitative techniques are structured social surveys and questionnaires with close ended questions, in which respondents answer a very rigid set of questions that allow the researcher to easily categorize information. In addition laboratory experiments and numerical methods such as mathematical modelling, structured observation, and content analysis are also techniques adopted in quantitative method (Neuman, 2000, Silverman, 2001, Fellows & Liu, 2003).

Silverman (2001) in referring to Bryman (1998) introduces four methods of research mostly used in quantitative approach. These include experiments, official statistics, structured observations, and content analysis. Silverman (2001) explains that experiments conducted providing stimulus would offer precise measurements, with respect to experiment with control groups not exposed to stimulus. Official statistics is analysis based on previously collected

data which, can be obtained in large data sets. Structured observation is based on information recorded and collected on predetermined schedule, and this approach depends very much on the reliability of the observations. Finally, in content analysis the researcher would have to predetermine categories to enable him count content of mass media products. However, there is the problem of reliability with regards to measurements (Silverman, 2001).

The quantitative techniques have one major disadvantage in that they do not allow individuals to explain their particular experiences. Whilst quantitative methods are strong on description, they are weak on explanation (Courtney et al., 2001).

Finally, in positivist model researchers' point of view is objective, neutral and independent of facts. Researcher begins his or her hypothesis with a general cause-effect relationship and relies on precedent theories. This model which converts ideas or aspects of the social world into general variables to form hypotheses is criticized for reducing people and systems into numbers, and for being based on abstract laws or formulas irrelevant of the actual lives of people or contextual particularities (Neuman, 2000, Fellows & Liu, 2003).

6.2.2. Interpretive model and qualitative research method

Interpretive research model is based on the works of German sociologist Max Weber (1864-1920), and German philosopher Wilhem Dilthey (1833-1911). This approach was developed in social science to study and describe meaningful cultural phenomena, and to understand and interpret the meaning of actions of the human beings. This approach also considers reality to be constructed by the persons involved. In contrast with positivist approach, this would imply that interpretation cannot be based on experimental and statistical demonstrations, and does not explain the "why" behind the occurrence of certain phenomena. Interpretive model is based on qualitative research method (Neuman, 2000, Fellows & Liu, 2003).

Qualitative research methods were developed to study social and cultural phenomena. Among qualitative techniques are action research, case study research and ethnographic research. They include interviews and questionnaires, documents and texts review, visuals' analysis, as well as the researcher's impressions and reactions resulting from researcher's observation of people specific behaviour in words, gestures, and tones. Silverman (2001), states that "the methods used by qualitative researchers exemplify a common belief that they can provide a 'deeper' understanding of social phenomena than would be obtained from purely quantitative data" (p. 32). This approach involves subjectivity and the risk of bias by participants, it is therefore important to consider the impact of social structure within the whole social context. Qualitative research is often criticized for the degree of subjectivity and lack of rigour in the techniques used. In addition analysis of data becomes more complex requiring filtering and sorting, and theory is grounded on data gradually collected and analyzed (Neuman, 2000, Fellows & Liu, 2003).

6.2.3. Triangulation between quantitative and qualitative methods

Triangulation involves using two or more research methods to study the same phenomena, such as using observational techniques in conjunction with structured interviews, using experiments in conjunction with interviews within a case study. In the field of surveying triangulation is a method adopted to fix a point in space with respect to two other points defining its distance and angular relationship with the other two points. The combination of qualitative and quantitative methods to research is expected to reduce or eliminate the disadvantages resulting from the use of one research method while benefiting from combining both methods (Neuman, 2000, Fellows and Liu, 2003).

Neuman (2000) introduces four types of triangulation research.

1. Triangulation of measures consists of taking multiple measures and aspects of phenomena, through different ways to enable researcher to see different or all aspects of the same phenomena and from different views.

The triangulation of multiple observers or researchers' data collected, with different backgrounds and social characteristics, instead of the analysis of data gathered by one observer would reduce the limitations of a study becoming more comprehensive.

2. The triangulation of theories is done through the use of multiple theoretical perspectives in either at the research planning phase or at the data analysis and interpretation phase.

3. The triangulation of methods is the Integration of quantitative and qualitative research methods and data to produce a more complete and comprehensive study.

Triangulation can be carried out using quantitative and qualitative methods sequentially, in parallel or simultaneously. Sequential approach may include iteration back and forth (Fellows & Liu, 2003).

6.3 Research method adopted for this study

This section of chapter six, describes the methodology adopted and applied in this thesis. It includes the approaches adopted to test and validate the hypotheses in order to fulfil the aims and objectives of this research. It also looks at the way data has been identified, collected, organized and interpreted. This chapter thus explains the approach used in the thesis to analyse the nature of the impact of the built environment form on the natural environment along the Lebanese coastal zone (LCZ) in general and on the area of Zouk Mosbeh (ZM) in particular, and to contribute to generalized knowledge.

First, an extensive literature review of the impacts of the built environment on the natural environment has been undertaken. This derives mainly from the sustainability paradigm based upon the Bruntland report (WCED, 1997) and the Rio documents (UN, 1992), which addresses sustainable development through a holistic approach to combine the three dimensions of sustainability, which are ecological, economic and social. Secondly the critical analysis of the

legislative framework of urban rules and regulations in Lebanon has shown serious problems mainly in the implementation of the latter, hence the negative impact of the built environment forms on the natural environment. Thirdly and in accordance with the above, triangulation approach to research was adopted as a method to combine the advantages of both quantitative and qualitative techniques.

The triangulation approach allows looking at the problem from a holistic perspective by the combination of the three dimensions of sustainability, the ecologic, the economic, and the social. Littig & Griebler (2005) in considering the difficulties between the analytical and normative aspects of conceptualizing social sustainability, they observe that social sustainability is both analytical and normative. "Social sustainability should furthermore be guided by an analytical concept that provides a sound theory regarding the relationship between society and nature. In any case, sustainability strategies and indicators should have both: analytical depth and clarity as well as clearly defined ideas about what kind of social values should be attained through sustainable development".

To this effect a case study was undertaken on the coastal area of Zouk Mosbeh (ZM), which allowed looking at the rapid development of the area, which has been unplanned and unregulated.

The advantage of conducting a case study is that it can follow either a quantitative approach or a qualitative approach; it can also combine both approaches conducting a triangulation research technique. For this reason, the triangulation has been chosen as our particular method of research.

Before the description of the research methods and techniques applied, the process of data collection and the characteristics of the respondents to our survey are discussed to show their capacity and competency. This allows the weight that can be put their responses to be gauged.

6.3.1 Process of data collection

Qualitative and quantitative data were obtained to validate the null hypothesis set out on page 6. This was done at two levels. Firstly, a detailed physical data was obtained about housing conditions in ZM, which involves physical measurements and observations of key variables. Secondly, a questionnaire was designed and used in obtaining data about the socio-economic conditions of ZM households.

The sample frame for the physical data include all households in ZM and the adjoining area of Adonis, which comprise of the original inhabitants and refugees displaced from other parts of Lebanon by the civil war (see appendix 7). However, given the impossibility of physically covering the entire sample frame or population a simple random sampling method has been employed in obtaining the necessary data and information crucial to the analysis. This is to ensure that the sample is unbiased and that each unit of the population has an equal chance or probability of being represented. Secondly, it ensures the impossibility of predicting which units of the sample are included or rejected. Thirdly, random sampling ensures the possibility of drawing a sample that will include every possible combination of units from the sampling frame irrespective of the combinations. The process of randomisation is discussed in the analysis of each the empirical data.

However, the first survey conducted was non-random hence the 'snowballing' sampling technique was used to target the office of the Vice President of the ZM Municipality for crucial data and information. The 'snowballing' sampling technique is where a subject under study leads to further subjects for study (Salganik, et. al. 2004). Although this technique has the advantage saving time and leading the researcher to authoritative sources of information, it nevertheless suffers from possible biases as samples are not selected from sample frames.

The Vice-President was interviewed using a semi-structured questionnaire and the reason for this is the fact that the municipality or local government plays a vital role in the development process. This is the case with regards to general urban management, particularly in the areas of infrastructure and service provisions. Indeed, following the last municipal elections in May 1998, which was the first elections after 15 years of civil war, the newly elected municipal bodies were required to assume more proactive roles in local development. The seriousness of the Central government can be seen in the decision taken to decentralise the economy and the desire to rebuild civil society (Arnaout, 1998).

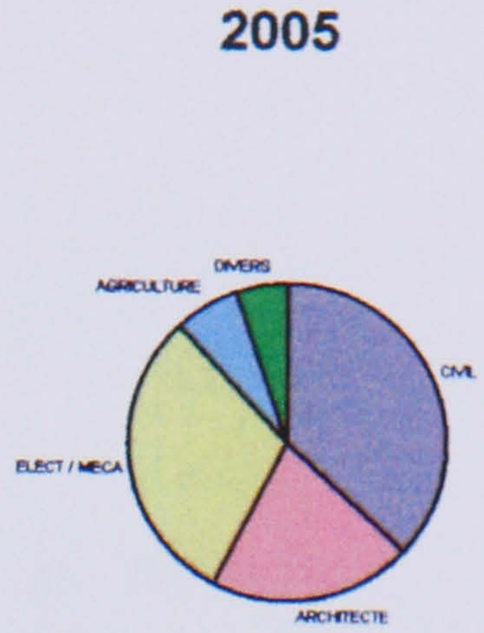
The structured interview was to throw some light on the socio-economic and environmental surveys relating to ZM. Thus, questions were focussed on the problems of the municipality and the strategy in place for addressing them.

The second data collection concerns the need to elicit the views of built environment professionals, including architects, building and civil engineers, and building contractors on the state of the biophysical and built environment of ZM. Given the impossibility of physically surveying all the built environment professionals in Lebanon, it was decided to randomly select a sample size using a sample frame. The sample frame was to concentrate on the built environment professionals that are currently active on the 2005 Lebanon register of Engineers and Architects (OEA) statistics year book. As Table 6.1 shows, the register reveals that the total number of registered Architects and Engineers in the OEA was 29679 (Order of Engineers and Architects, 2007).

Table 6.1

Total Engineers as per specialization

2005		
الاختصاص	العدد	النسبة %
CIVIL	10709	36.1%
ARCHITECTE	6128	20.6%
ELECT / MECA	9125	30.8%
AGRICULTURE	2012	6.8%
DIVERS	1705	5.7%
TOTAL	29679	100%



Source: Order of Engineers and Architects, 2007 (p.33)

Table 6.1 shows that of the total 29679 registered built environment professionals, 36.1 percent are civil engineers, 20.6 percent are architects, 30.8 percent are electrical and mechanical engineers, 6.8 percent are agricultural engineers, and 5.1 percent work in other sectors of the economy. This was used as a guide to the distribution of questionnaires between the built environment professionals. However, it was further decided to engage those members on the register that are active in order that the views and information gathered not only represent the views of the total sample size through random selection of samples from the register but also that such views are informed by current professional engagement and activities in the industry.

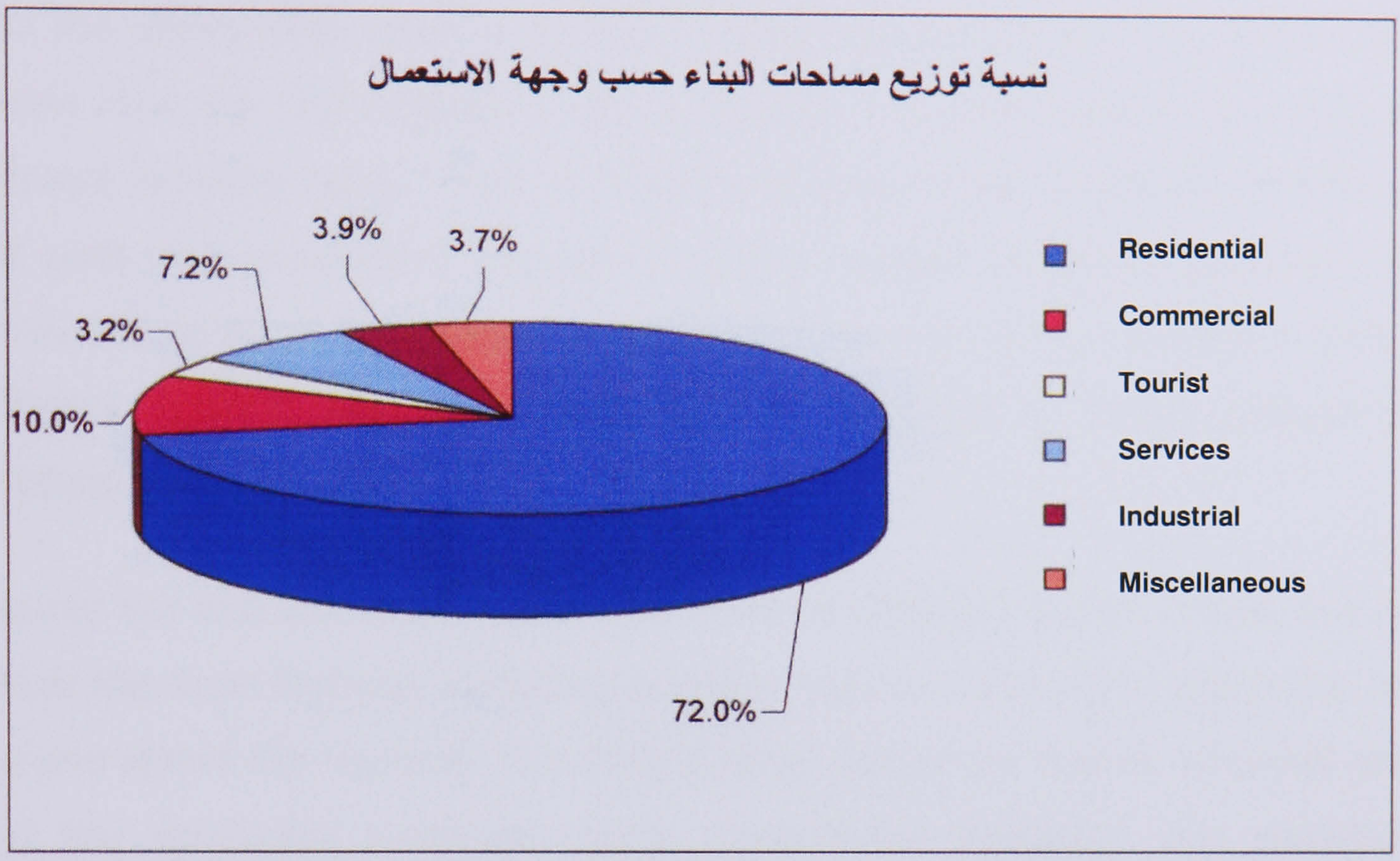
As a result, it was found that among the 10709 Civil Engineers, 1531 were active as consultants and 306 were active as contractors. Furthermore, 1571 Architects of the 6128 registered were active as consultant while 121 Architects were active as contractors. The rest of the Civil Engineers and Architects registered at the OEA either were employee in the public sector or worked as educators, or work abroad.

Regarding the physical infrastructure sampling, a sample frame of building activities according to use was designed to indicate the predominant use or purpose of buildings in the area. Figure 6.1 shows that residential building,

which accounts for 72% of total building activities in ZM in 2005, which can be said to be true for the rest of Lebanon albeit to a lesser extent.

Figure 6.1

Building Activity versus Type



Source: Order of Engineers and Architects, 2007 (p.46)

Nevertheless, OEA statistics show that the majority of building activities in 2004-2005 were mainly concentrated in the area of Mount Lebanon. In the South of Lebanon 1021 building permits were issued (BPF) compared to 48 BPF in North Lebanon, 445 BPF in the Bekaa Valley, and 105 in Beirut (Order of Engineers and Architects, 2007).

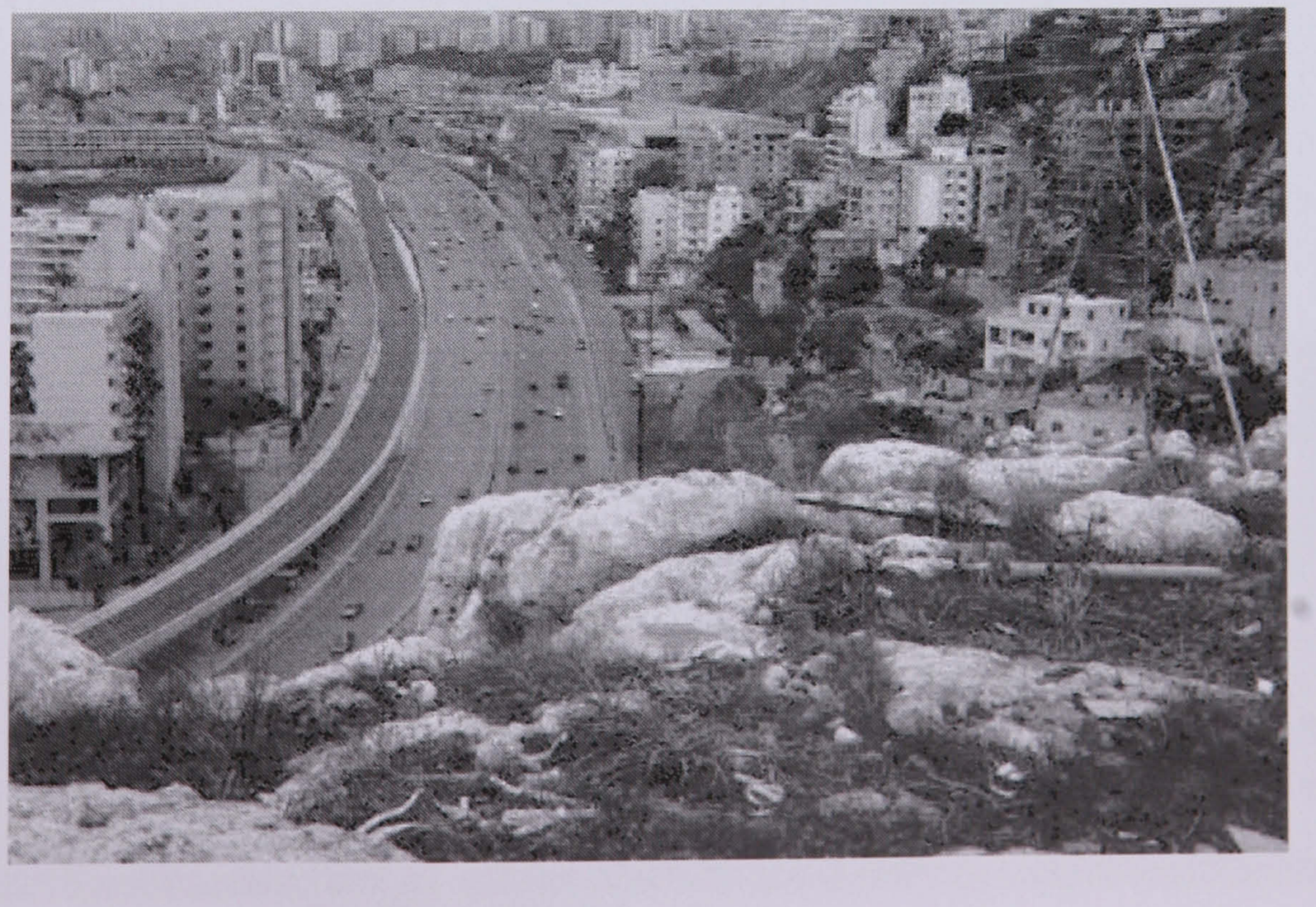
Survey questionnaires were used to obtain socio-economic and cultural data attributes of households while data and the physical and thermal characteristics of buildings were obtained through measurements and field observations where photographic evidence and other vital information were recorded. The expectation was that a better understanding of the state of the built environment in ZM can be achieved by combining socio-economic and physical measurement data. It is further expected that doing so will facilitate an effective policies towards the sustainable rehabilitation of the biophysical environment of ZM.

Using the historic aerial photographs from the General Directorate of Geography of the Lebanese Army shown in appendix 3, which details the different types of residential houses and buildings as well as agglomeration of houses in the area of ZM, samples were selected at random using the sample frame presented in Figure 1. The survey covered the different sectors of ZM and the street map used is shown in appendix 3. In particular, Appendix 8 shows how the municipality of ZM is divided into eight sectors revealing the different building types. Thus, a random sample of the residential building in ZM area was conducted, focussing on the number of floors, structural and enclosure systems, roof and orientation, and thermal comfort sensation data at different times of the year. However, it is important to briefly analyse the physical attributes of ZM.

Figures 6.2 and 6.3 show sector one which is divided into two zones, the one below the main highway including summer resorts to the left of figure 6.2, and the one above the highway, including a small part of the Adonis industrial area, and few residential buildings mainly medium-rise buildings, one vernacular house, and two low-rise buildings that have developed along the main highway. To the west of the sea side of ZM are summer resorts that can be seen to have seriously encroached on agricultural land (Appendix 8, sector 1).

Figure 6.2

ZM; Sector 1



Source: El Asmar (October 2002)

Figure 6.3

ZM; Sector 1, above the Highway

Source: El Asmar (October 2004)

Sectors 2 and 3 of ZM include the "Adonis" residential area. Figure 6.4, shows dense and unplanned combinations of residential medium-rise, low-rise, and the only remaining vernacular house in the area (appendix 7, and appendix 8 sectors 3, and 4). It can be observed that reinforced concrete is the main material used and the buildings are clustered together, which prevents adequate views, privacy, and ventilation. The major part of the questionnaires and observations regarding medium-rise, and low-rise buildings were collected mainly from these two sectors.

Figure 6.4

Sectors 2 and 3, Adonis Residential Area

Source: El Asmar (October 2004)

In sector 4 is located the "Adonis" industrial area. The impact of this industrial area, in figure 6.5, which is located in proximity of the residential area and within which residential buildings were also built was considered throughout the work (appendix 8, sector 4).

Figure 6.5

Sector 4; Adonis Industrial Area

Source: El Asmar (October 2004)

Sector 5 represents the oldest core of ZM, which includes the historic centre, and as it can be seen from Figure 6.6, there are few vernacular houses numbering about 10 exist in the area.

Figure 6.6

A traditional Street in ZM

Source: El Asmar (November 2004)

However, the transformations and additions to old houses such as in figure 6.7, and the developments of new medium-rise buildings occur without any reference to rules and regulations that consider height, setbacks, and use of local materials. This is further visible in Figures 6.7 and 6.8.

Figure 6.7

Transformed traditional house in ZM

Source: El Asmar (November 2004)

Figure 6.8

Transformed Old Core of ZM

Source: El Asmar (November 2004)

Sector 6 includes the northern part of the historic sector. However, Figure 6.9 shows a row of modern medium-rise residential expansion can be observed to be encroaching on the natural environment. In front of these buildings and to the extreme north east is an industrial area linking with Jeita (appendix 8, sector 6).

Figure 6.9

Sector 6; Expansion Zone of ZM

Source: El Asmar (February 2006)

Sectors 7 and 8 which could be considered the cultural and remaining agricultural areas of ZM include the northern Nahr el Kaleb river ravine, on the top of which is mainly a school and a university. Figure 6.10 shows the road running parallel to the river and deep into the valley of Nahr el Kaleb and on the right are the "staeles", which have been described previously. This road represents the southern boundary of ZM.

Figure 6.10

Nahr el Kaleb Valley

Source: El Asmar, October 2002

In order to gauge the extent of sustainable building practices in Lebanon a questionnaire was designed and distributed among randomly selected architects and other built environment professionals through the use of the Internet. Preliminary results from this exercise have been presented at the International conference on passive and low energy architecture PLEA 2005 (Appendix 4 and 5).

The aim of the questionnaire was twofold; firstly to understand the level of awareness, and level of implementation of sustainability policies and practices amongst built environment professionals in Lebanon, and secondly, to understand possible reasons for acceptance or resistance to sustainable behaviours and practices. The rationale being that if sustainability culture exists in Lebanon's built environment sector, it should be noted with these firms that are at the forefront of the nation's physical development. The questionnaire was divided into four different sections to reveal the characteristics of respondents, their sustainability awareness, barriers to changing attitudes, and respondents' view on strategy and policy.

Based upon the figures gathered from the OEA and described previously in this chapter, one hundred of the most active architectural practices and construction firms, dealing with residential architecture, were randomly selected in the area of Mount Lebanon.

The questionnaire was sent out in the middle of July 2005, and after three weeks only 40 questionnaires were returned, representing 40 percent response rate. Apart from the fact that the incidence of low response rate to research question is typical of the construction industry, the situation in Lebanon at the time may also have contributed. It was during this period that the former Lebanese Prime Minister, Mr. Rafic Hariri was assassinated. Assassinations of a seasoned journalist, Mr. Samir Kassir, and the former head of the communist party soon followed. This created huge political tension and many people remained in-doors for a while before venturing into offices and other places of

work. It is however hoped that the effects on our results and hence conclusions and recommendations would be minimal.

A questionnaire addressed to the inhabitants of ZM and its related area Adonis, was designed and stratified and based on six different issues (Appendix 5).

1. Background of the household
2. Income Status
3. Consumption patterns (water, and electricity)
4. Disposal patterns (water waste and solid waste)
5. Comfort (thermal, air quality, etc.)
6. Awareness and Participation

While these issues remained the focus of the questionnaire, the capacities of households to participate and influence urban policies were also gauged. The questions were divided into two parts. The first part was close ended and looked quantitatively at respondents' awareness of energy consumption issues; ways to reduce energy consumption, and recycling of domestic solid waste. The second part looked at the relationship between respondents and the municipality. This included questions of qualitative nature with open-ended structure, allowing respondents to give personal opinions in relation to possible ways of improving the urban area of ZM.

A few samples of the questionnaire were first sent to randomly selected addresses in the area of Zouk Mosbeh to test the type of response likely to obtain. The response was very disappointing. In addition section five of the questionnaire was dedicated to the analysis of ZM residents' general comfort and particularly indoor thermal comfort. This consisted in scheduled observation quantitative techniques in the form of measurements of the air temperature, relative humidity, air velocity, and mean radiant temperature. The clothing (Clo) value of ensemble worn by the subjects, together with their metabolic rate (Met) were also observed and estimated.

The field survey of thermal comfort within the three types of buildings was undertaken in spring season 2005, in the summer season of 2005, and in the winter season of 2006. Mid-season is concerned with fall and spring, during which the climate along the coastal line is relatively the same, with almost identical temperatures and humidity averages (Republic of Lebanon 2003). Figure 6.11 shows a partial sample from section 5 in the questionnaire conducted in ZM. It contains three different tables; the first table shows the predicted mean vote (PMV) reported from measurements and estimations. The second table (1) indicates the actual mean vote (AMV) and is related to the subjective sensation of the subjects during the survey, and the third table (2) indicates the best sensation according to the subject.

Figure 6.11

Thermal Comfort Sensation

The heating was made by a heater which make the temperature normal The clothes was normal winter clothes.

6 What is the yearly rate you pay for municipal solid waste collection?
..... USA $ per month

Section 5: Comfort (thermal, air quality, etc.)
NB: This table is for interviewer use only

	Time/Date	T °C	% RH	V/s	MRT°C	Clo	Met	
Winter	12:50	21	74	1,3	15	0,140	70	heating On PMV = -1,3 PPD = 42,7
Mid-season	10:15	21	50	0.9	29	0.080	98	PMV = -2.6 PPD = 94.9
Summer	12:15 pm	33	57	0.7	41	0.050	58	PMV = +2.8 PPD = 97.9

-3 -2 -1 0 +1 +2 +3

1. Please indicate in the scale below your thermal comfort:

	Cold	Cool	Slightly Cool	Neutral	Slightly Warm Neutral	Warm	Hot
Winter			✓				
Mid-season				✓			
Summer					✓		

-1,3
-2.6
+2.8

2. Please indicate in the scale below how you would like our thermal comfort?:

	Cold	Coo	Slightly Cool	Neutral	Slightly Warm Neutral	Warm	Hot
Winter					✓		
Mid-season				✓			
Summer			✓				

A thermal comfort prototype software that was developed by Loveday et al. (1997) and the 7-points ASHRAE sensation scale were used here to calculate the actual mean vote (AMV) and the predicted mean vote (PMV). The reported thermal comfort sensations were compared with values predicted from EN ISO7730 (1994) for different seasons. The mean air speed (m/s) and air temperature (T°C) were measured using a hot-wire anemometer. Relative humidity rate was measured by a digital instrument. A globe thermometer was used to measure globe temperature (MRT°C); mean radiant temperature was then determined by empirical equation. The full results and analysis are presented in chapter 7.

6.4 Experience during field survey

Due to the nature of the questions and the necessity of collecting data such as measurements it was decided to conduct the survey personally. Care was taken to minimize the risks of misunderstandings arising from translations of the words describing the points on the various scales by interviewing the respondents and assisting them with completion of questionnaires. This enabled also to take notes (Figure 6.10) on whether the air conditioning system was on, or a fan, or other as well as to collect and measure data such as the clothing coefficient and the metabolic rate necessary to complete the information related to indoor thermal comfort.

The data collection involved visits from house to house however, not all households approached agreed to participate in the survey. This was probably due to the fact that during the morning, it is mostly women members of the household that are present and they avoid receiving any male who is either not a husband or a relative. This obviously has much to do with culture and religion dimension. A group of three females had therefore to be trained in order to help in the data collection. They were introduced accordingly to the subject matter and the objectives of the exercise as well as the special measurement instruments to be used in the exercise.

Finally, it is important to add that during data collection one of the intensions was to organize a workshop involving all stakeholders in the ZM area. The program of the workshop was intended to pave the way for a first awareness and participatory approach to municipality management in Lebanon. It would have required the presentation by the municipality to describe and clearly inform the citizens about its future plans for the rehabilitation and physical development of the area, current works and how money paid through taxes is spent. In return, it was expected that the citizens' representatives would have raised their concerns, opinions and oppositions. This would have also served to spread the information learned and collected by this study, and evaluate the willingness of residents to actively cooperate and participate in the sustainable rehabilitation of ZM.

The vice-president of the municipality expressed his interest in the idea but was of the opinion that it will not be possible to arrange and conduct the workshop for fear of possible fear for real confrontation. Given the delicate situation following the assassination of the Prime Minister at the time, the plan was shelved. There could be many explanations to such issues, however a third party probably within the education fields, supported by appropriate campaigns of capacity building, and legal framework based upon general governmental agenda and policies, would have to prepare all the stakeholders to start changing attitude towards a democratic, participatory, and interactive type of approach.

The collected data have been analysed to define and evaluate the main built environment problems of ZM as viewed by its inhabitants. It has also formed the basis for the quantitative analysis undertaken using SPSS-10 statistical package. In addition qualitative analysis of photos, maps, field observations and notes, were used to buttress the quantitative analysis provided.

CHAPTER 7

ANALYSIS OF RESULTS AND DISCUSSION

7.1 Introduction

This chapter analyses the data gathered from the ZM building survey, the questionnaire survey of inhabitants, building professionals, and the semi-structured interview conducted with the ZM municipality. The first part of this section takes into consideration the physical data, while the second part is concerned with the socio-economic data analysis. The results of this analysis provide the basis for suggesting appropriate guidelines for the sustainable rehabilitation of ZM.

7.2 Physical data analysis

In order to start the physical data analysis, the different buildings within the eight sectors of ZM where the questionnaires and measurements randomly took place were photographed. The randomization criteria considered the number of existing buildings in ZM and their location to cover the different municipal sectors. In addition it was necessary to seek the approval of the inhabitants to repeat the measurements three different times. Furthermore, only inhabited traditional buildings were considered in the survey, and these are located mainly in sectors 5 and 6 (appendix 8, sectors 5 and 6); Low rise buildings are mainly spread in sectors 2 and 3 (appendix 8, sectors 2 and 3); Medium rise buildings are mainly spread in sectors 2, 3, 4, 5, 6, and in sectors 1, 7, 8 mixed with industrial, commercial, and other activities (appendix 8, sectors 1-8).

Table 7.1 shows the number of residential buildings according to each category in the municipal area of Zouk Mosbeh. It clearly illustrates that among 1210 residential buildings in the area 1.9% belongs to the category of traditional buildings, 4% belongs to the category of low-rise buildings, and 93% medium-rise residential buildings.

Table 7.1

Number of buildings in ZM versus category

Building Category	Total number of buildings in ZM	Percentage
Traditional	23	1.9 %
Low-rise	56	4 %
Medium-rise	1131	93%
Total number of buildings in ZM	1210	100%

Source: Municipality of Zouk Mosbeh

The data collected from the questionnaires was inserted into SPSS 10.0 for Windows to determine frequencies and percentages to allow an appropriate quantitative analysis. The data was then divided into three categories that described the different physical characteristics of these buildings:

- Traditional building
- Low-rise building
- Medium-rise building

Table 7.2

Building Category Studied

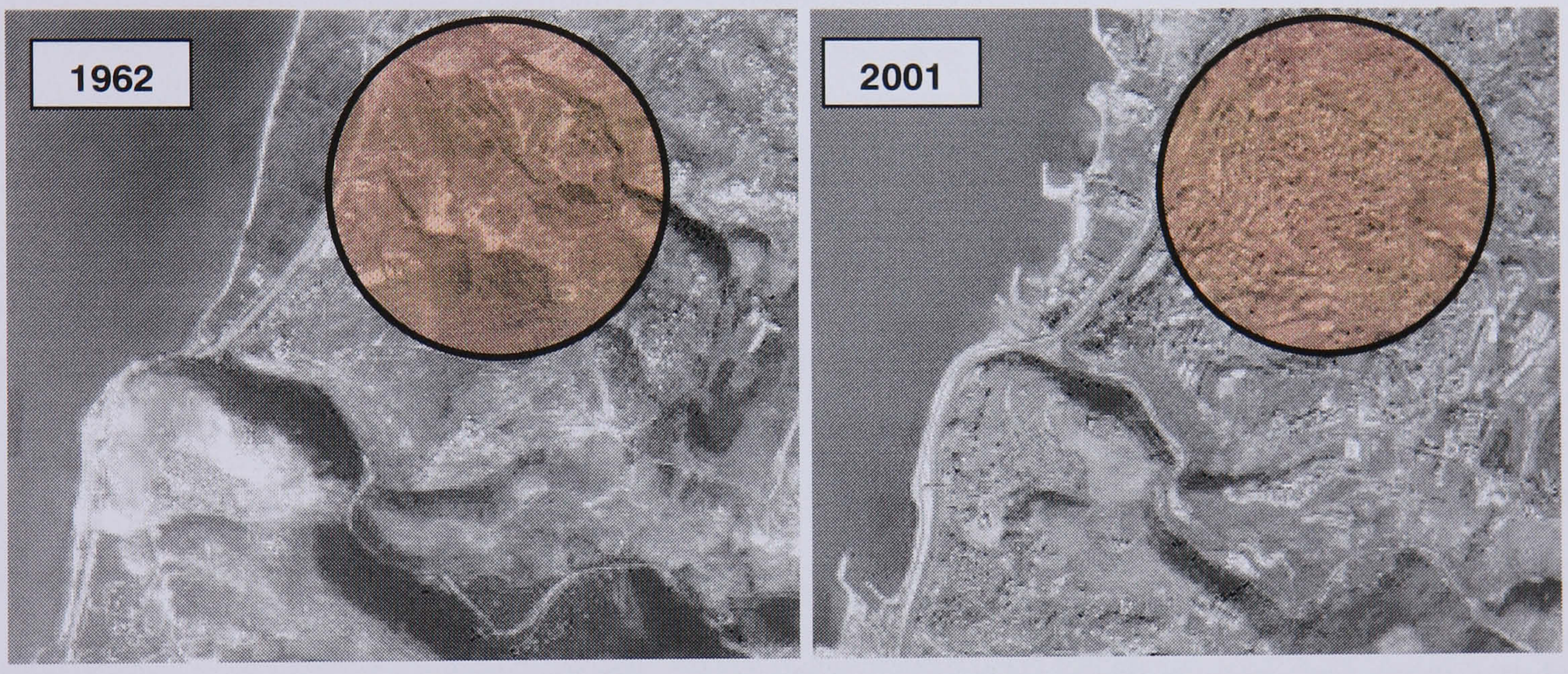
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Medium rise	61	79.2	79.2	79.2
	Low rise	14	18.2	18.2	97.4
	traditional	2	2.6	2.6	100.0
	Total	77	100.0	100.0	

Table 7.2 summarizes the housing types covered in the survey. It shows that traditional houses accounts for 2.6% of the sample sizes while low-rise

buildings commands 18.2% depicts, and 79.2% being mainly-medium rise buildings. In addition the percentage of Low-rise buildings would have been greater if the plan that was laid out for the residential part of Adonis was implemented as discussed previously in section 5.3.2. Figure 7.1 represents a visual comparison between two aerial photos. The first was taken by the Director General of geography in the Lebanese army (DGA) in 1962 and 2001 respectively. In addition to field survey and observations, these prove the density of medium-rise buildings in all the sectors of the area and especially in circled "Adonis" area.

Figure 7.1

Aerial Views of ZM



Source: adapted from Lebanese Army (DGA).

7.2.1. Traditional building

To fully appreciate the impact of new buildings and the transformation of ZM to an urban setting, it is necessary to highlight the characteristics of traditional buildings. The significance of doing this is to show the benign impact of these buildings on the biophysical environment as well as the wider social-economic benefits. Table 7.2 aptly describes the main physical attributes of the traditional buildings in ZM.

Table 7.3

Physical characteristics of the typical traditional houses in ZM

Floor (s)	Maximum of one floor and ground floor
Structural system	Local bearing stone masonry walls of 50-100 cm thickness. An external stone masonry layer, an internal stone masonry layer. The inner core is filled with rubble. Originally the walls were built dry without mortar.
Enclosure system	The vertical structural systems of bearing walls enclose the internal space. The thickness and technological system of the walls makes of it a thermal mass. In addition opening the enclosure walls through windows and /or doors on both sides (West and East) allowed cross ventilation decreasing therefore the high coastal relative humidity.
Roof system	If not vaulted (barrel vault), it was generally flat and consisted of a timber structure overlaid with a reed matting, a layer of thorny brush, that grows abundantly in Lebanon and pressed down with moist earth (30 to 50 cm thick). This type of roof, has efficient thermal transmittance value, has been replaced in many cases by a reinforced concrete thin slab (10 to 20 cm thickness) highly decreasing its efficiency. Pitched roof is also used and it is made of a wooden frame, overlaid with brick tiles.
Orientation	Along the coastal line traditional houses are oriented with the main elevation (longer) towards the sea to the West. The problem of the low inclination of the sun and the negative effect of glare was dealt with by a galvanized steel frame bearing vines and creating beneficial shadows in summer and allowing sun to penetrate in winter.
Greening	As it is clearly seen in the photos around these houses, trees and other plants create an appropriate micro-climate improving thermal comfort and decreasing pollution.

Traditional houses in ZM are either in ruin or uninhabited as it is clearly visible from figure 7.2. The few inhabited houses have undergone some changes and alterations in their contextual and/or in their physical form. These changes owe to many reasons.

Figure 7.2

Traditional Houses along the LCZ highway in ZM

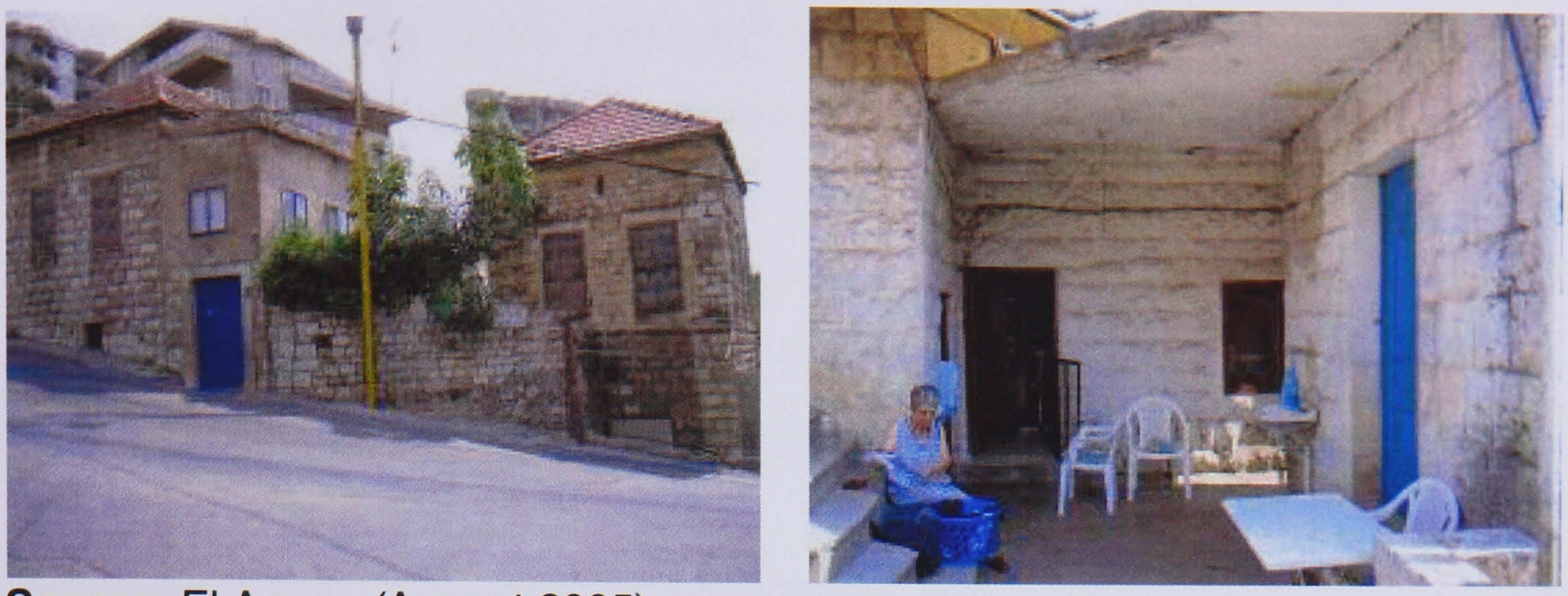
Source: El Asmar (November 2004)

The house in Figure 7.2 to the right is currently inhabited by foreigners working in the construction field. It experienced contextual transformation due to the introduction of the main highway along the LCZ. The transformation from rural to urban setting comes with its own problems in the forms of noise pollution and environmental pollution, and social-costs. The social-costs to original inhabitants include high land prices and housing rents forcing them out of the land and forestalling poverty.

Figure 7.3 shows a traditional house which has also been transformed. A secondary road was introduced in front of the entrance door of the house. The lady in the figure is one of the survey's respondents. In the interview conducted with her, we discovered that she lived alone, and that her two sons wanted to demolish the house to replace it with a modern building to provide her with a bigger modern house. Despite the alterations and changes to the original context, the lady refused the offer, saying that she was happy and satisfied living in her original house. This shows for example that despite the pressure for modernisation, there are still supports for traditional housing, albeit by the older generation.

Figure 7.3

Traditional House in ZM



Source: El Asmar (August 2005)

As Figures 7.4 and 7.5 shows, the transformation from rural to urban setting is associated with the physical alterations of traditional ZM houses. This is hardly surprising given the pressure that normally accompanies urbanization, especially the need for additional living space. Nevertheless, these changes induce negative environmental effects by reducing or eliminating cross-ventilation. This also has huge energy consumption implications because the loss of cross ventilation necessitates the use of air conditioning system. Indeed, there is a huge difference in the energy constituents of modern and traditional buildings given the different embodied energy characteristics. For example, it is well known that reinforced concrete masonry embodied energy is more than 200 GJ compared to stone masonry, which is around 100 GJ (Australian Government, 2005). Thus, the intensive use of conventional energy has serious implications regarding CO2 emissions and climate change.

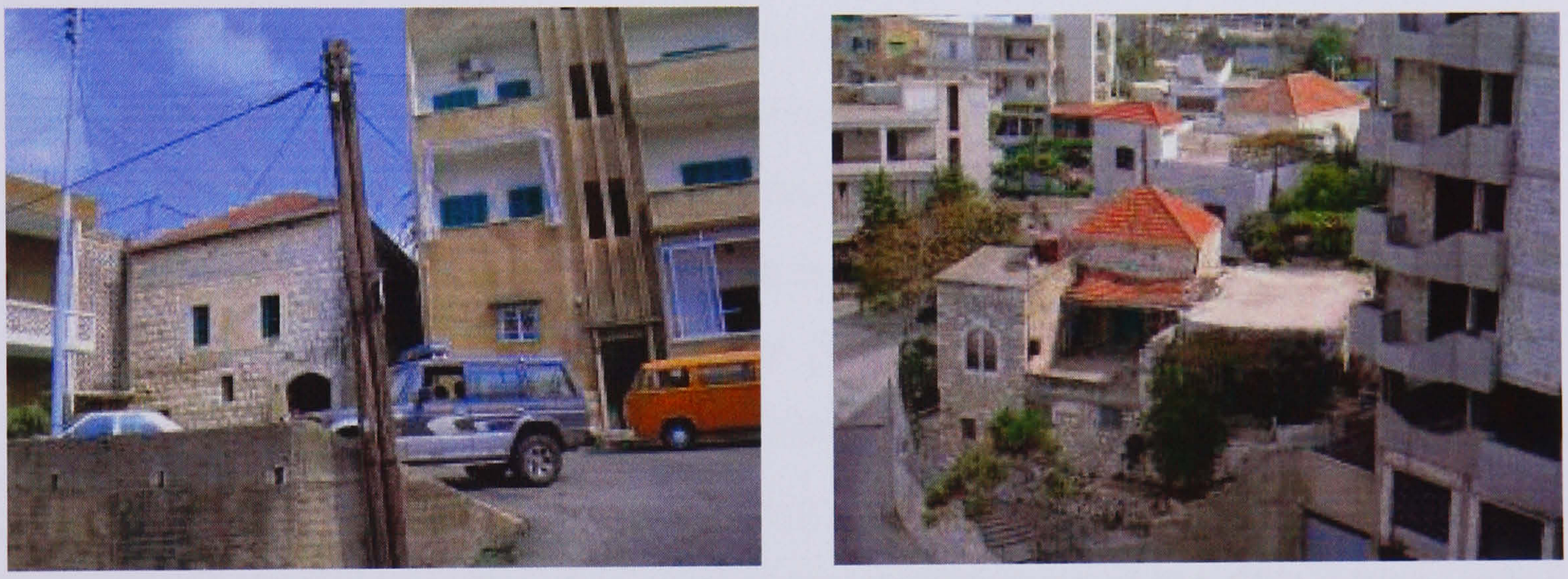
Apart from the energy and benign environmental attributes of traditional houses, there are also huge socio-economic benefits associating with the conservation or rehabilitation of traditional houses. Such benefits include wider and diversified employment opportunities for local people and this can have the effects of enhancing and strengthening socio-cultural revival, social cohesion, and peace and security. This is particularly the case for Lebanon that has just emerged from 15 years of protracted civil war and with pervasive unemployment, especially amongst the rural population. Reviving traditional

building methods has the potential to revive local skills and businesses relating to traditional building materials.

However, increasing family size and overall increase in the population has resulted in the extension of some of these houses by the addition of extra living spaces. Also, new habits and modern ways of life have lead to changes and the location of bathrooms and kitchens away from the outside to inside of the houses. This pressure for additional space has intensified that households have to choose between rehabilitation and new build.

Figure 7.4

Traditional Versus New Housing in ZM



Source: El Asmar (August 2005)

Figure 7.5

Traditional Versus Modern Buildings in ZM

Source: El Asmar (August 2005)

Figure 7.5 clearly shows the use of concrete as a material in the alteration and additions to existing traditional houses. The traditional technology of thick thermal mass walls between 80 and 100cm are now replaced by one layer of 10 to 20 cm concrete masonry. This has major implications for achieving thermal neutrality, especially in an environment employing natural ventilation system. This has led to the use of air conditioning as a mechanical mean for heating and cooling which, is recognized as an energy intensive solution.

7.2.2. Low rise building

This category of dwellings has started appearing in the area since the mid of 1960's when the owners of the Adonis hill in the area of ZM decided to partition the land into plots of around 1000 m^2 to build residential construction (figure 7.1). According to the plan drafted for Adonis the average ratio between the total area of each plot and the percentage built up area allows building to a maximum of two floors above ground floor. However, of this category there are only few examples in Adonis and this is due to the unplanned development that occurred during and after the civil-war (1975-1990). From table 7.1 it is clear that of the 77 surveyed buildings in ZM 18.2% belong to this category. It is important here to mention that from our site observations and surveys it was noticed that building technologies and the architecture of the 60's which, relied mainly on reinforced concrete and influenced by western Architecture, environmental issues were not taken into consideration. Table 7.3 aptly describes the main physical attributes of the low-rise buildings in ZM.

Table 7.4

Physical Characteristics of Low-rise Buildings in the Study

Floor (s)	Maximum of ground floor and one to two floors
Structural System	Reinforced concrete skeleton (columns and slabs) structure on spread footings.
Enclosure system	One layer of 20cm hollow concrete blocks (HCB) or two layers of HCB 10cm + 5cm of cavity between the two layers of walls + cement plaster on both sides + paint coating and in some cases or a combination of stone facing and paint coating in other cases.
Roof system	Concrete slab of 25 cm thickness topped with or without bituminous membrane, 10cm sand layer and 2cm tiles or pitched roof built in concrete slab of 20-25cm topped with bituminous membrane, or coated with waterproofing material. Above the concrete slab a layer of spaced rafters above which a linear distribution of purlins topped with brick tiles. This arrangement of wood or steel structure laid over a concrete slab to support the brick tiles decreases the transmission of heat from outside to inside during hot summer days increasing thermal insulation of the roof system.
Orientation	The criterion followed for the orientation of the buildings in this category depends only on the shape of the plot with no regards to climatic factors.
Greening	As it is clearly seen in the photos around these houses trees and other plants create an appropriate micro-climate improving thermal comfort and decreasing pollution.

Figure 7.6, shows two different low-rise houses in the area of "Adonis". Reinforced concrete is used for the building structures. The enclosure system is made of a cavity wall of 25 cm and a 3cm stone facing layer. Although concrete masonry units are used instead of the traditional thick stone walls, the air cavity and the thickness of the walls allows less reliance on mechanical means. The roof is flat and finished with waterproofing and bitumen mat. The mat is then covered with a layer of coarse gravels. The light colour of gravel has good reflection qualities and this would decrease heat due to direct sunlight in summer.

Figure 7.6

Low-rise Buildings in Adonis, ZM

Source: El Asmar (August 2005)

Figure 7.7 shows a low-rise house, a "villa" on two levels. The enclosure system is similar to the other examples in figure 7.6. However, the roof system in the case is pitched and covered with red brick tiles.

Figure 7.7

Low-rise Building in Adonis, ZM

Source: El Asmar (August 2005)

7.2.3. Medium rise building

Clearly visible from Figures 7.8 and 7.9 are the huge numbers of medium-rise buildings and their bulk and density in the area of ZM.

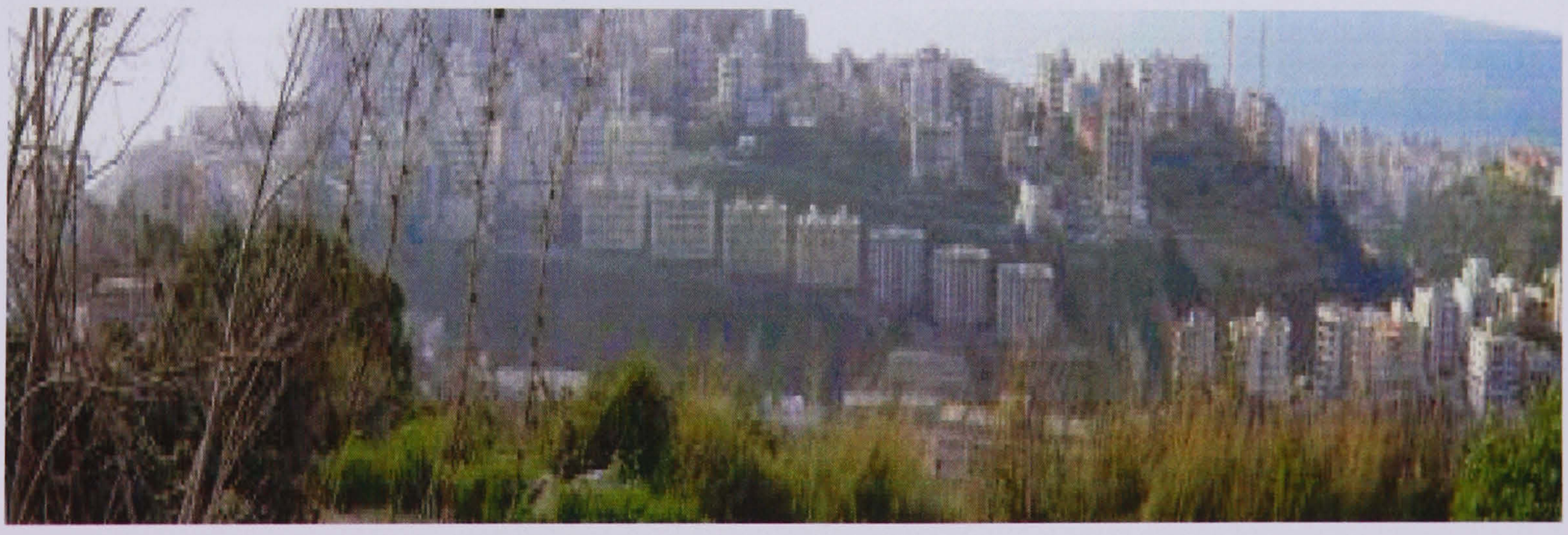
Figure 7.8

Area of Adonis in ZM

Source: El Asmar (November 2005)

Figure 7.9

ZM from the area of Jeita to the West



Source: El Asmar (November 2005)

This category of buildings has started appearing in the area since the mid 70's and has also spread haphazardously in and around the area. The Lebanese civil war and the total disorganization and disregard of building rules and regulations, by all stakeholders (municipality, professionals, developers, etc.), was detrimental to the area. Medium-rise buildings sprang high and hap-

hazardously to render them unsustainably in the area of ZM. These unsustainable patterns are reflected in both the built environment and the natural environment. Deforestation, unfinished buildings, visual pollution, high air pollution, energy consumption especially for heating and cooling, inefficient solid waste and waste water disposal are few examples of unsustainable built environment patterns.

Table 7.4 aptly describes the main physical attributes of the low-rise buildings in ZM.

Table 7.5

Physical Characteristics of Medium-rise Buildings in the Study

Floor (s)	Underground: generally used for parking, deposit, or including a water reservoir for all the building and technical room (mechanical and electrical). Ground floor, generally elevated on (pilotis) columns, used as car parking, and a closed area for a small apartment (guardian) of a maximum of 30m², with the buildings main entrance, elevator and vertical circulation. Repetitive floor: These are generally constituted of one, two or three apartments per floor, varying approximately between 100 m² and 200 m².
Structural system	Reinforced concrete skeleton (columns and slabs) structure on spread footings.
Enclosure system	One layer of hollow concrete blocks of 15 to 20 cm (in general 15 cm is the most common) + cement plaster on both sides + paint coating. Some of the surveyed buildings or either unfinished with steel reinforcement on hold or internal spaces none enclosed, or waiting to be painted.
Roof system	Concrete slab of 25 cm thickness. In general these roof systems are not waterproofed and thermally insulated, increasing heat in summer and energy loss in winter for the last floor. In addition the lack of waterproofing allows water to leak through into the residences.
Orientation	The criterion followed for the orientation of the buildings in this category depends only on the shape of the plot with no regards to climatic factors.
Greening	Greening is not considered at all as being part of the project; it is only a left over of the excavation and building process.

Figure 7.10 clearly shows a reinforced concrete structure of an unfinished building to the left and one floor reinforced concrete house with steel reinforcement on hold for future addition of floors to the right. The enclosure wall is composed of a single layer of 15cm concrete masonry. The house on the left is unfinished while the one on the right is plastered and white washed.

On the wall of the house on the right photograph an air conditioning split unit is clearly visible indicating the reliance of the inhabitants on energy intensive solution for heating and cooling.

Figure 7.10

Unfinished Medium-rise Buildings in Adonis

Source: El Asmar (August 2004)

Figure 7.11 depicts different examples of medium-rise buildings in ZM. The use of reinforced concrete is evident. A single layer of 15 to 20 cm concrete masonry unit plastered and painted and single glass glazed windows with very low thermal insulation properties, forms the enclosures, and 25 to 30 cm reinforced concrete horizontal roof system, in general lacking waterproofing and thermal insulation. The huge amounts of embodied energy resulting from this built environment, in the forms of direct and indirect energy consumption are directly accountable for environmental degradation. This is also due to the extent of renewable and non renewable natural resource input to build these constructions.

The unplanned clustering of these buildings, as the third photograph to the right in figure 7.11 clearly shows, with no care to orientation, increases further the reliance on energy intensive solutions; this has also adverse effects on the problem of noise as well as privacy. The problem of aesthetic or visual pollution is real and should be considered very seriously for its negative impacts on people and the spirit of the place (Shultz, 1979).

Figure 7.11

Medium-rise Buildings in ZM

Source: El Asmar (August 2004)

The analysis of the physical data from the field survey clearly substantiated by the results obtained from the questionnaires carried out in the same buildings and clarifies the reasons behind the unsustainable patterns of water and electric energy consumption, and the quality of thermal comfort. Air and noise in the area of ZM are also clearly revealed. In addition the results of the secondary data analyzed in section 5.4 corroborate also these findings.

7.2.4 Water Consumption

Lebanon's main natural resource is water. It is important to note that in Lebanon, precipitation occurs generally between the months of November and April, which often means many up-drying off-seasons. Lebanon has 17 perennial streams and around 23 seasonal ones. In addition, groundwater, which is enriched by snow cover, is estimated to range from 400 to 1000Mm^3. Table 7.5 is extracted from Republic of Lebanon (2001), which refers to various sources, and shows the approximate water balance in Lebanon, taking into consideration the yearly precipitation, and yearly average flows decreasing relatively the availability of water.

Table 7.6

Water Flow in Lebanon

Description	Yearly average flows (Mm^3)	
Precipitation		8600
Evapotranspiration	4300	
Surface water flows to neighbouring countries		
• Flow to Syria		
El Assi River	415	
El Kebir River	95	
• Flow to Israel	160	
Hasbani River	(670)	
Groundwater seepage	(1030)	
Net potential surface and groundwater available		2600
Net potential surface and groundwater		2000

Source: Republic of Lebanon (2001)

However, the state of the environment report (Republic of Lebanon, 2001) is of the view considers that the quantity of available net potential water is not appropriately used and this is due to the lack of investments towards the preservation of this water, while investments are directed towards tapping water resources. Adding to this the negative effects of human activities, consumption and disposal (generating polluted water, from sewage disposal in the groundwater, or industrial, etc.) patterns, for agricultural (irrigation), industrial, domestic, recreational and hydropower (generation of electricity) use (Republic of Lebanon, 2001).

The situation of water in the area of ZM is not healthy, although the major part of the inhabitants is connected and regularly pay the annual fees for water supply, they do not regularly receive water (table 7.6). In addition the water rarely received is not potable. This unsustainable situation creates several adverse effects on the wellbeing and health of the people, on the natural, and the built environment;

- Drinking water is treated by regional authorities, and then distributed through to the households. However, water quality has been on the decline due to cross contamination by waste water network, and rusting water pipe conduits (Republic of Lebanon, 2001).

- Purchasing water from private distributors, which are also uncontrolled, does impact on the natural environment, because of the unplanned, unorganized and uncontrolled methods of extraction.

- The analysed data shows that purchasing both bottled water, and water from private distributors, adds to the economic burden on people, who already pay the yearly water bill, which ranges between 100 and 200 US$ to the municipality, and are forced to pay additional fees to the private companies to purchase both bottled and privately extracted water.

According to the analysis of the questions in section three of the questionnaire (Appendix 5) 82% of the 77 respondents receive water from the public network almost regularly, while 5.2% although connected and paying taxes do not receive water regularly, and 11.2% of the respondents are not connected to public water network and do not receive water. It is important here to mention that in Lebanon, it is not compulsory to have a contract with the public water services company.

Table 7.6 shows that although connected, most of the respondents around 66.2%, do not drink from public water supply.

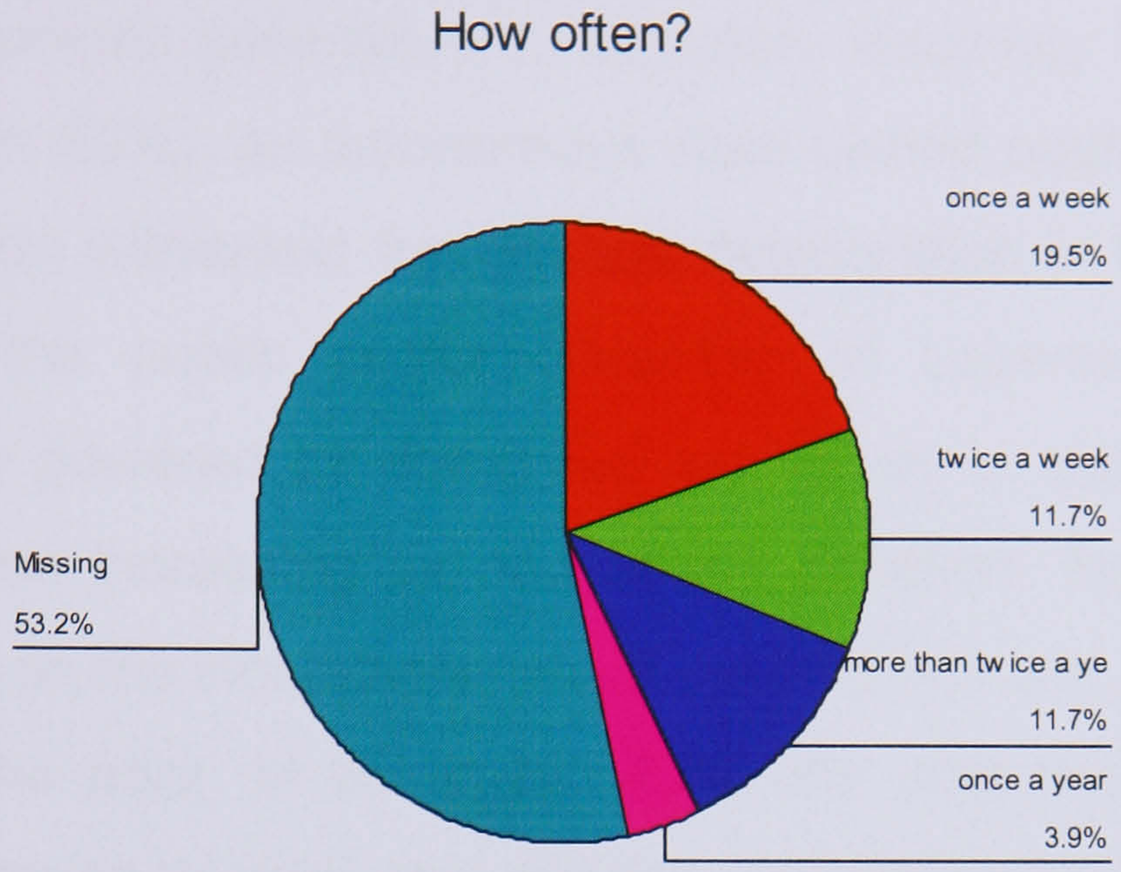
Table 7.7

Cross tabulation Count; Receiving Drinkable Public Water

		Do you drink from public water?		Total
		Yes	no	
Do you receive public water?	yes	23	40	63
	no	1	11	12
Total		24	51	75

When asked how they source for drinking water, 58.4% answered that they purchase bottled water, and 13% fill their tanks from water fonts in the mountains. 48.1% of the respondents purchase water from private distributor. Figure 7.12 shows how often they have to purchase water:

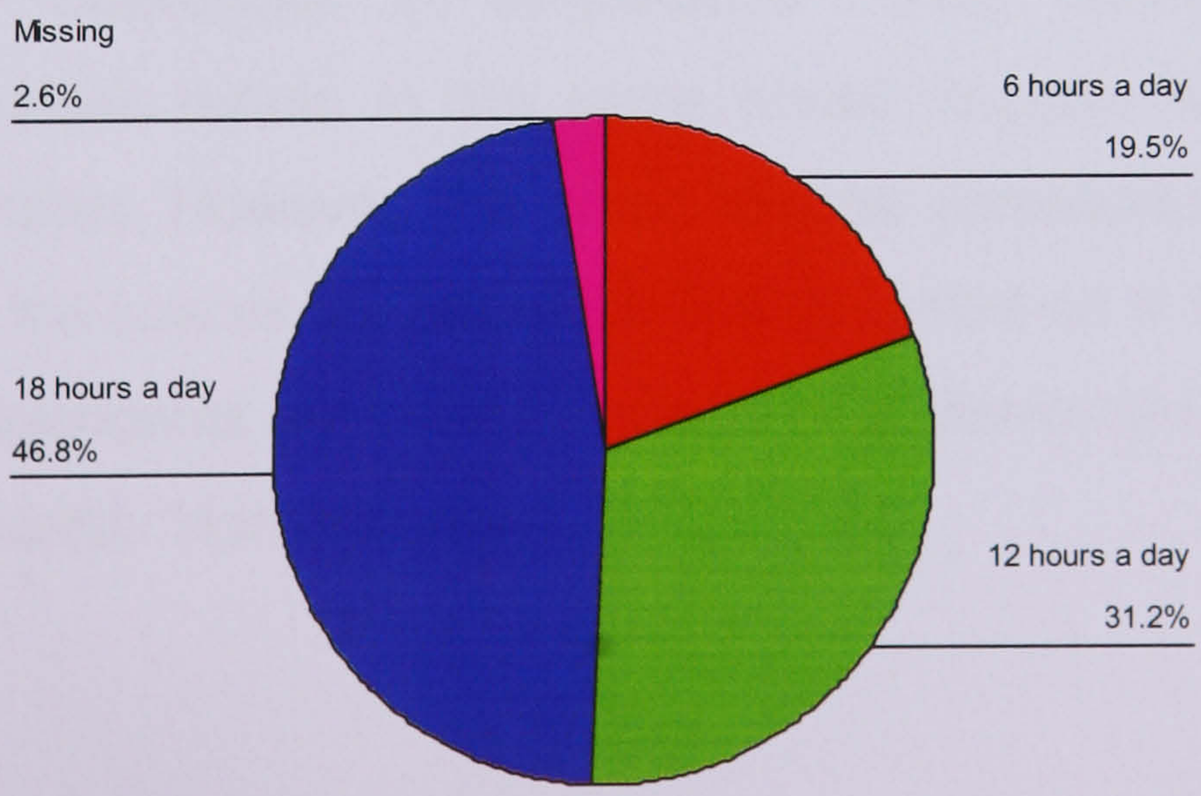
Figure 7.12



7.2.5 Electric energy consumption

Although connected to the public grid, 97.4% of the respondents are displeased with electricity supply. Figure 7.13 shows that electricity distribution occurs irregularly in the different areas of ZM and ranges between 6 hours daily and 18 hours daily.

Figure 7.13



In inquiring on how people manage during electric cuts; 96.1% of the respondents use private generators. In Lebanon, electricity is supplied by the Electricité du Liban (EDL), an autonomous state owned public utility. The 1975 civil-war in Lebanon witnessed the gradual deterioration in both services and load supply to the public sector (Republic of Lebanon, 2001). Private generators mostly powered by diesel fuel are widely in use. This situation is unsustainable given increasing air and sound pollution. Aside there is huge economic burden on the inhabitants, which only the rich can absorb, leading to fuel poverty by the poor. In the case of ZM the data analysed shows that inhabitants are forced to pay the regular connection to the grid, ranging between $20 a month to $150 a month, to avoid being disconnected, and the private generators, whose bill, range between $20 and $60 a month, is continually rising.

Table 7.8 shows a major reliance of ZM households on both electric and butane gas space heating and cooling Very few have installed central heating systems. The use of electric systems for heating and cooling increases non-renewable energy consumption to provide indoor thermal comfort in the summer and winter seasons. However, the heating and cooling in the households is not uniformly distributed. Local air conditioning split units or moving electric or butane gas units, would improve the thermal conditions in the rooms in which they are located, while the other spaces of the household will experience differences in temperature. Thus, sudden changes in temperature between rooms in the same house impacts negatively on the health of households. However, this could also be considered energy efficient especially when the spaces are not used. This is confirmed in the next question in which the respondents are asked: “how is heat distributed in your house?” and 70.1% answered: “non uniformly”.

Table 7.8

Percentage of Installed Heating Systems

Type of installed system used only for heating	Percentage
Central diesel fuel heating system	18.2%
Central butane gas heating system	10.4%
Electric heating units	50.6%
Butane gas heating units	40.3%
Wood stove units	1.3%
Split units used only for heating (heat pumps)	27.3%
Chimney	2.6%
Central air conditioning used only for heating	3.9%

Table 7.9 shows that the same problem applies for cooling. For which 77.9% of the respondents answered that cooling is non-uniform in their houses, as they rely on either one or combinations of the systems below (i.e. fans and split units)

Table 7.9

Percentage of Installed Cooling Systems

Type of installed system used for cooling	Percentage
Electric fans	57.1%
Split heating/cooling units (heat pumps)	53.2%
Central air conditioning heating/cooling units	10.4 %

However around 30% of respondents migrate to their original home-towns in the mountains during the summer. This is particularly the case since the end of the civil-war and cessation of hostilities between the different communities living in the same areas that were once divided. This can be interpreted as a positive move especially with respect to energy consumption because in the mountains there is hardly any need for cooling during the summer season as explained in chapter 3. This has the likely effects of decreasing the energy consumption for cooling and the attendant pollutions.

A further investigation into thermal comfort and thermal sensation of the respondents in ZM area was undertaken to understand the percentage of satisfaction of the respondents with respect to the thermal environment in the area and to investigate the validity of the current standards BS EN ISO7730

(1994). The British Standard BS EN ISO 7730 (1994) defines thermal comfort that condition of mind that which expresses satisfaction with the thermal environment. In terms of bodily sensations, thermal comfort is a sensation of hot, warm, slightly warm, neutral, slightly cool, cool, and cold. These bodily sensations are translated in to the 7-point ASHRAE standard sensation scale respectively from +3 as hot, +2 as warm, +1 as slightly warm, 0 as neutral, -1 as slightly cool, -2 as cool, and -3 as cold. In order to calculate the predicted mean vote (PMV) of thermal satisfaction, four environmental parameters were measured, and two personal parameters were estimated. These were air temperature, globe temperature, air velocity, relative humidity, clothing, and activity. These measurements were carried out in the summer season, autumn season, and winter season. As previously explained (Republic of Lebanon, 2003) autumn and spring in Lebanon are considered mid-seasons, and this is because of the similar climatic conditions. The predicted mean votes (PMV), obtained through calculation, of the respondents relative to each season, was compared with the actual mean votes (AMV), or actual thermal sensation of respondents during the survey.

Figure 7.14

Building Categories and Winter PMV and AMV

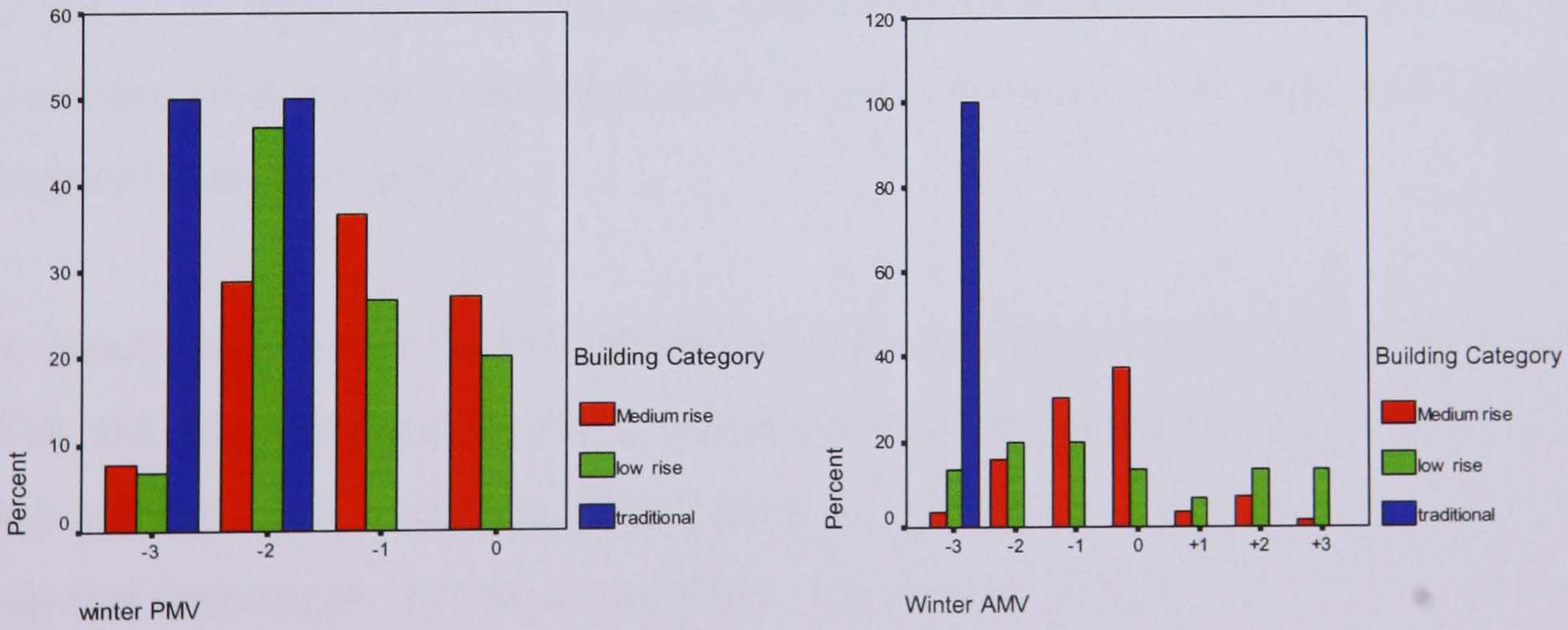


Figure 7.14 shows the overall thermal sensation for a winter season of the 77 respondents in three different types of buildings, and the comparison of PMV and AMV.

Winter PMV predicts that around 22% of respondents in the category of low rise buildings (CLRB) and around 28% of the respondents in the category of medium rise buildings (CMRB) should feel neutral. Winter AMV shows that 14% of subjects in CLRB, and around 40% in the CMRB actually voted neutral (0).

In the CMRB, PMV graph predicts that 74% of subjects are dissatisfied with their winter thermal sensation; 38% voted slightly cool (-1), 28% voted cool (-2), and 8% voted cold (-3). Figure 7.14 shows that 60% of subjects in the CMRB are actually dissatisfied; 30% feel slightly cool (-1), 18% feel cool (-2), 3% feel cold (-3), 3% feel slightly warm (+1), 4% feel warm (+2), and 2% feel hot (+3). Although the responses are differently divided in this category, an agreement of a general dissatisfaction is clear between PMV and AMV in this category for winter votes.

In the CLRB, PMV graph predicts that 80% of subjects should be dissatisfied with their winter thermal sensation; 26% of responses tend towards slightly cool (-1), 48% cool (-2), and 6% cold (-3). AMV graph shows that of 85% of subjects in the CLRB are actually dissatisfied; 20% feel slightly cool (-1), 20% feel cool (-2), 14% feel cold (-3), 4% feel slightly warm (+1), 14% feel warm (+2), and 14% feel hot (+3). Although the votes are differently divided in this category too, an agreement of a general dissatisfaction is clear between PMV and AMV in this category for winter votes.

The results also show that respondents in the category of traditional buildings (CTB) are dissatisfied and this is evident from the graphs for winter PMV and AMV, Winter AMV indicates that 100% of responses tend towards cool(-2), while the responses in the winter PMV are divided into 50% tending towards cool (-2) and another 50% towards cold (-3).

Figure 7.15

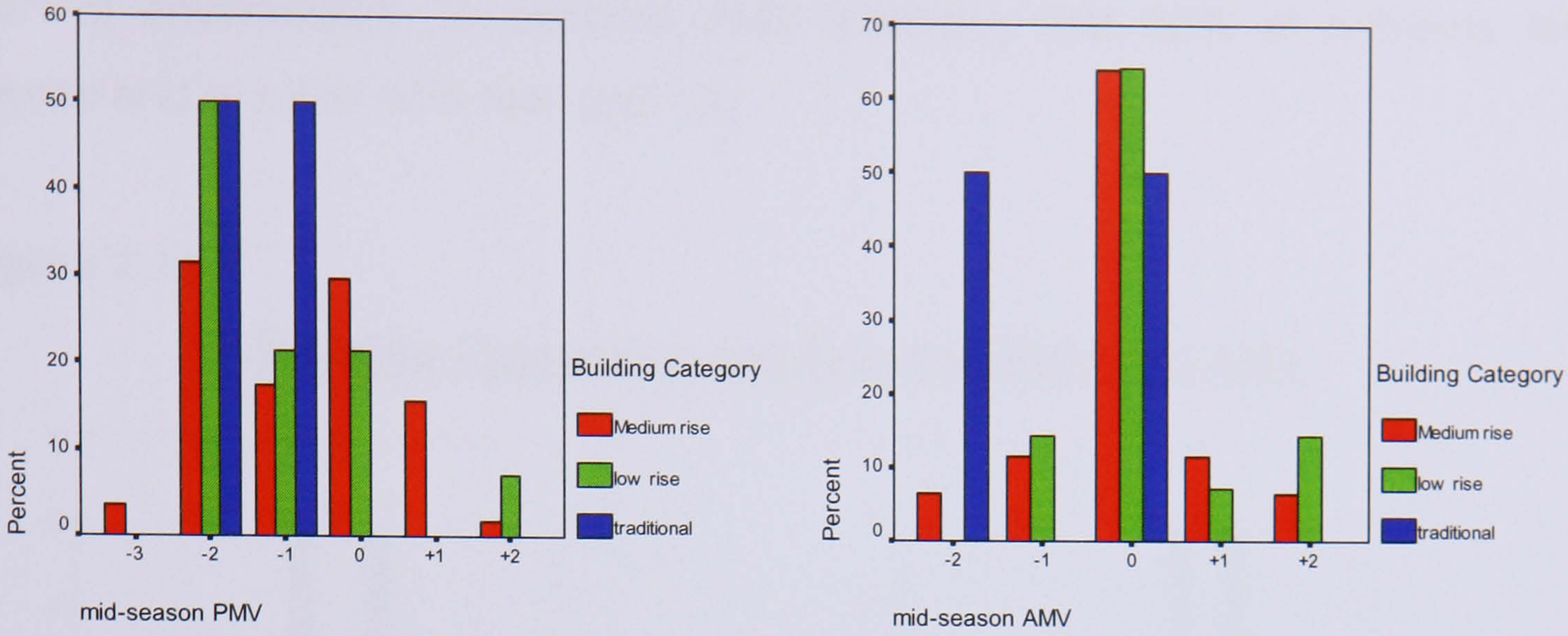


Figure 7.15 shows the overall thermal comfort sensation for a spring and autumn season of the respondents in different buildings showing the comparison between PMV and AMV.

Mid-season PMV predicts that around 22% of respondents in CLRB and around 30% of the respondents in CMRB should feel neutral. Mid-season AMV shows that 65% of subjects in CLRB, 64% of subjects in CMRB, and 50% of subjects in CTB claimed to be neutral (0).

In the CMRB, PMV graph predicts that 70% of subjects should be dissatisfied with their mid-season thermal sensation; 17% voted slightly cool (-1), 32% voted cool (-2), and 4% voted cold (-3). AMV graph shows that 36% of subjects in the CMRB are actually dissatisfied; 12% feel slightly cool (-1), 6% feel cool (-2), 12% feel slightly warm (+1), and 6% feel warm (+2). The results show clear disagreement between mid-season PMV and AMV in this category.

In the CLRB, PMV graph predicts that 78% of subjects should be dissatisfied with their mid-season thermal sensation; 22% of votes tend towards slightly cool (-1), 50% cool (-2), and 6% warm (+2). AMV graph shows that of 35% of subjects in the CLRB are actually dissatisfied; 14% feel slightly cool (-1), 7% feel slightly warm (+1), and 14% feel warm (+2). In this case too the results show clear disagreement between mid-season PMV and AMV in this category.

PMV results also show that subjects in CTB should be dissatisfied with their thermal environment. In contrast AMV indicates that 50% of subjects feel neutral and another 50% feel cool (-2).

Figure 7.16

Building Categories and Summer PMV and AMV

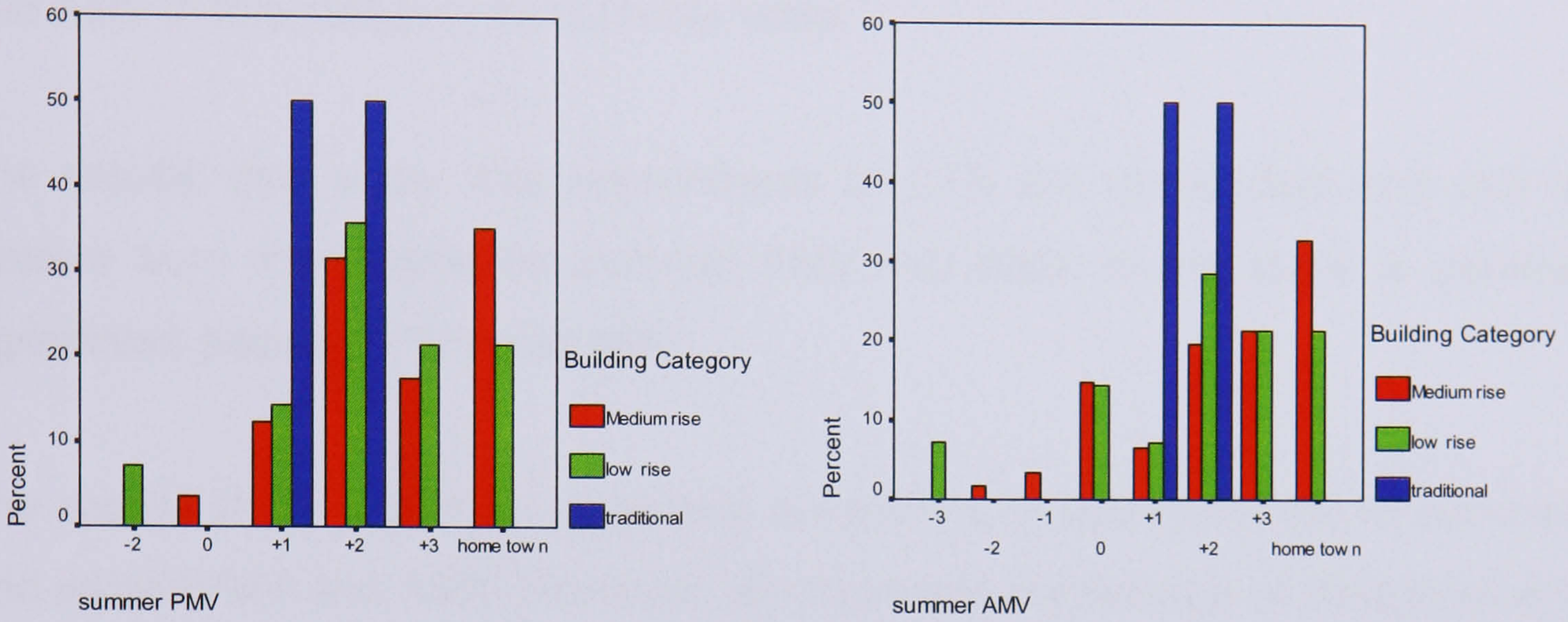


Figure 7.16 shows the overall thermal comfort sensation in a summer season, together with the comparison of PMV and AMV for different buildings.

Summer PMV predicts that around 4% of the respondents in the category of CMRB should feel neutral. Summer AMV shows that 14% of subjects in CLRB, and around 15% in the CMRB actually voted neutral (0).

In the CMRB, PMV graph predicts that 61% of subjects should be dissatisfied with their summer thermal sensation taking into consideration that 35% are absent; 12% voted slightly warm (+1), 18% voted warm (+2), and 35% voted hot (+3). AMV graph shows that 52% of subjects in the CMRB are actually dissatisfied; 3% feel slightly cool (-1), 2% feel cool (-2), 6% feel slightly warm (+1), 20% feel warm (+2), and 21% feel hot (+3). Although the votes are differently divided in this category, an agreement of a general dissatisfaction is clear between PMV and AMV in this category for summer votes.

In the CLRB, PMV graph predicts that 76% of subjects should be dissatisfied with their summer thermal sensation taking into consideration that 22% are absent; 14% of votes tend towards slightly warm (+1), 35% warm (+2), and 22% hot (+3). AMV graph shows that of 64% of subjects in the CLRB are actually dissatisfied; 7% feel cold (-3), 7% feel slightly warm (-2), 28% feel warm (+2), and 22% feel hot (+3). Although the votes are differently divided in this category too, an agreement of a general dissatisfaction is clear between PMV and AMV in this category for summer votes.

The results also show that respondents in CTB are dissatisfied and this is evident from the graphs for summer PMV and AMV. In this there is general agreement between PMV and AMV.

The results show that there is general agreement of dissatisfaction in summer and winter PMV and AMV. However, an important percentage of disagreement is in the mid-season votes, whereas PMV predicts low percentages of neutrality, AMV gives in the three building categories votes that exceed 50% of neutrality. This could be explained in the fact that people have adapted to their thermal environment. This result is also confirmed in Table 7.10, when people were asked if they are generally satisfied with their thermal environment, and 61% answered positively, while 37.7% answered negatively and 1.3% answered yes and specified in winter.

Table 7.10

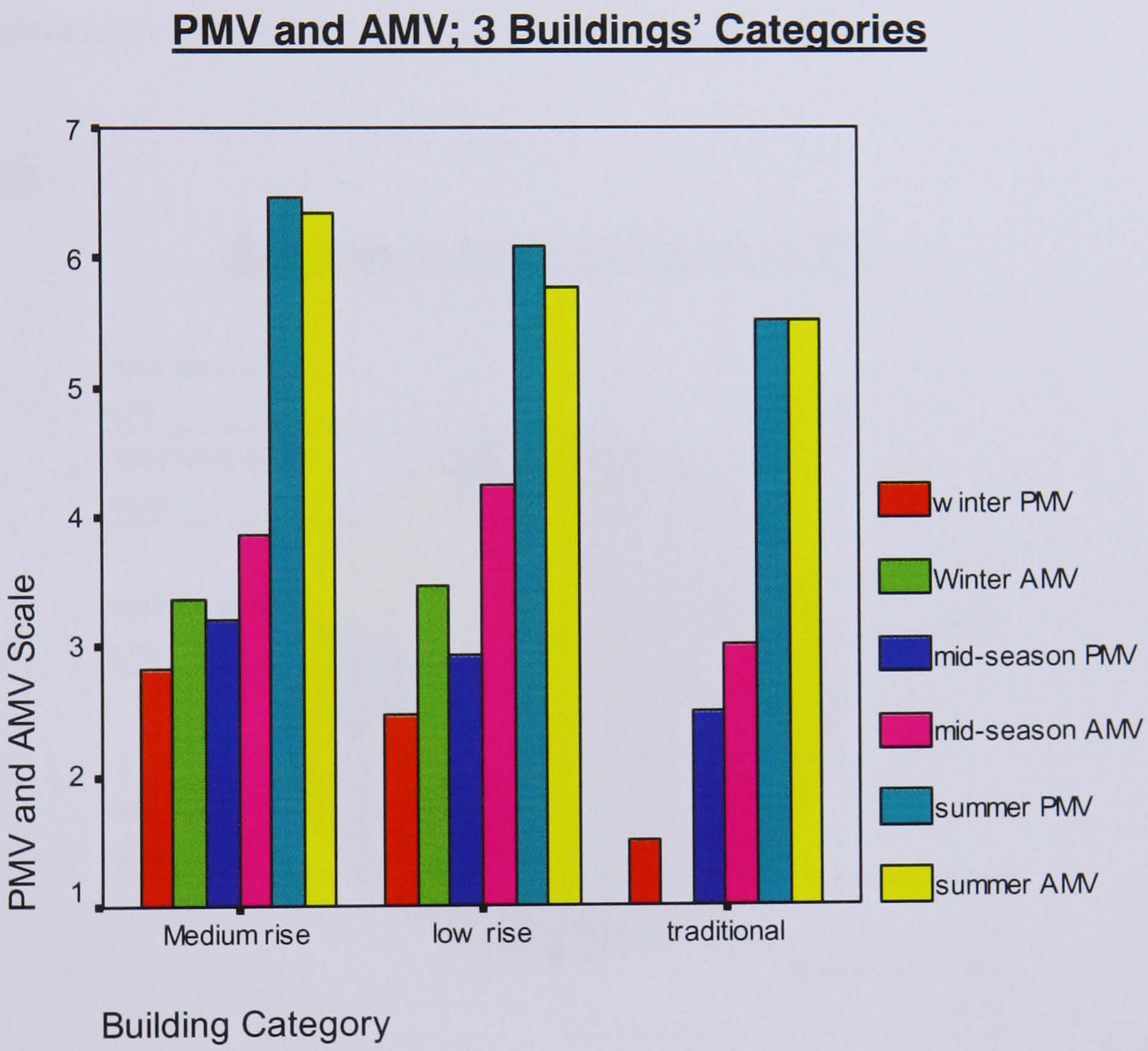
Are you generally satisfied with your thermal environment?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	47	61.0	61.0	61.0
	no	29	37.7	37.7	98.7
	yes in winter	1	1.3	1.3	100.0
	Total	77	100.0	100.0	

Finally, figure 7.17 groups together the averages between PMV and AMV in the different seasons and in the three categories. The y-axis compares the mean

value between PMV and AMV related to thermal sensation, and x-axis related to the three building categories. Each point in Figure 7.17 represents an average vote of 69.8% of subjects in medium rise building, 12.95% of subjects in low rise building and 2.29% of subjects in traditional buildings. In this case the PMV and AMV scale ranges from 1 as cold to 7 as hot and 4 as neutral. It can be seen that there is general agreement between PMV and AMV for these buildings showing that ISO7730 is valid for predicting the thermal comfort in such environments.

Figure 7.17



7.2.6. Air and noise pollution

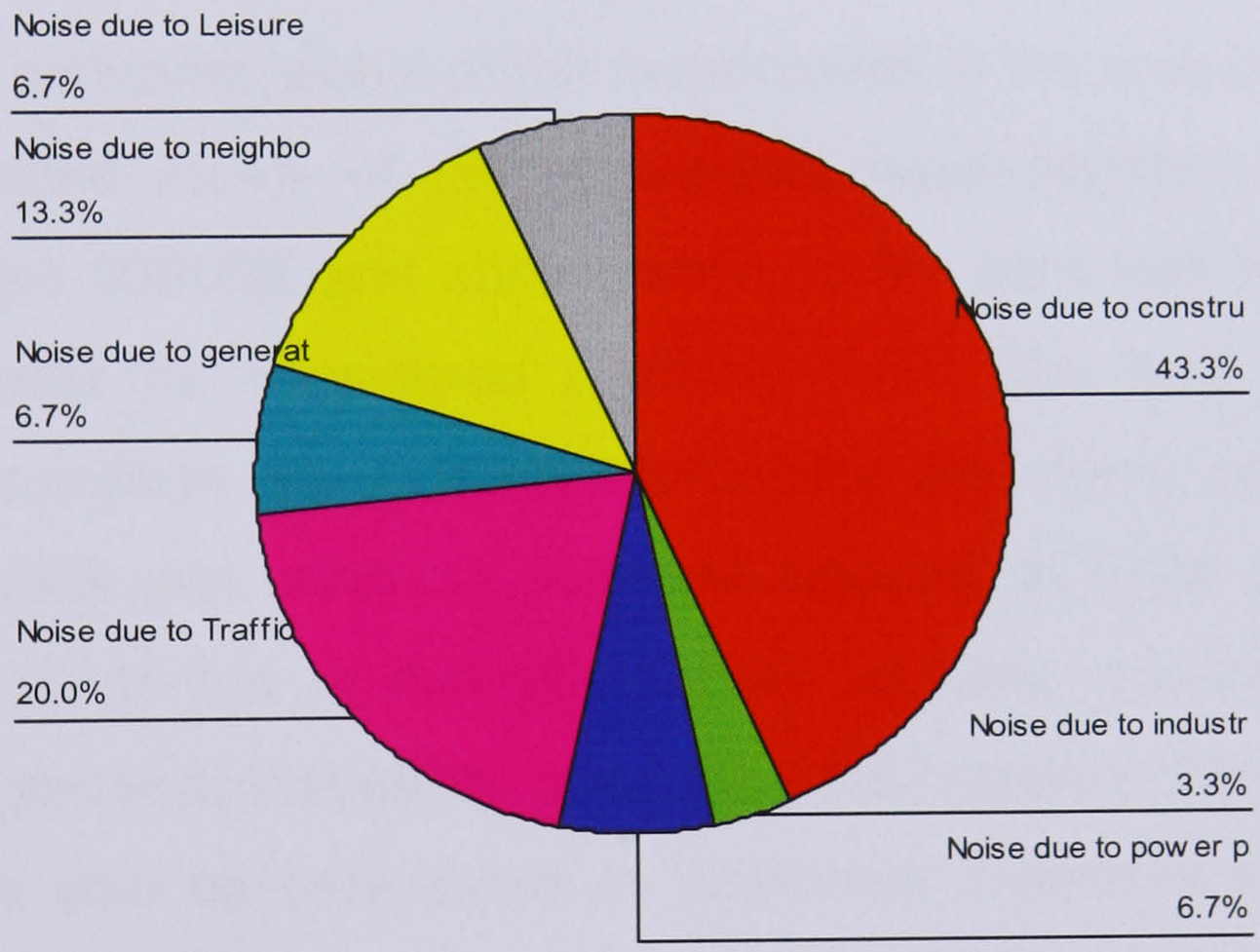
Section 5.4 of the questionnaire analyses the air quality and noise pollution in the ZM area. The result shows that 57.1% of the 77 respondents regard the air quality of their built environment to be poor and unsatisfactory while 37.7% considered it satisfactory. Nevertheless 5.2% are satisfied with current air quality. A further probe of the source of discomfort reveal the problem revolves round dust, smokes, and bad odour. Indeed, about 65 % of respondents blame their discomfort on dust, smoke, and bad odours, which they argue emanate

from industrial pollution. The problem is further exacerbated by the nearby power plant, which in addition to thermal generators, emits environmental pollution in Lebanon. Similarly, 30% of respondents blame their discomfort on noise and fumes from traffic pollution and the inappropriate and inadequate sewage system.

Concerning acoustic pollution 48.1% of the respondents considered noise a major problem in the area while 49.4% disagree. However, a disaggregate analysis of sources of noise in Figure 7.21 shows that noise from construction activities predominates with 43.3%. This means those at home during the day when construction activities take place are most affected.

Figure 7.18

Sources of Noise Pollution in ZM



According to figure 7.18, noise from construction activities (43%) and traffic (20%) constitute the major sources of noise pollution in ZM. This has not been helped by the major highway running through ZM. Noise from leisure activities comes third with 20%, and neighbourhood with 20%, thermal electric generators and power plants command 13.4 %, while industry contributes 3.3%.

7.3. Income Status of Households in ZM

The analysis of the data related to the income status of the ZM inhabitants reveals the affordability of these to change attitude towards sustainability in the built environment. This issue is directly related to the concept of poverty which has a wide range of meanings in contemporary economics. Ikeme (2004) revealed two dominant approaches to the concept of poverty; absolute poverty and relative poverty. He defines absolute poverty as the "inability of individuals or families to achieve minimal standards in fulfilling basic human needs such as food, clothing, shelter, health, education, and sanitation services (Ikeme, 2004, referring to Reddy et al. 1997; p.42). The concept of relative poverty is a more holistic approach and includes "... whatever the custom of the country renders it indecent for creditable people, even of the lowest order to be without" (Ikeme, 2004, referring to Adam Smith in his work" The wealth of nations"; p.42).

Looking at the economic status of the respondents in the area of ZM, it can be noted that around 75.4% of the respondent have monthly income salary ranging between 500US$ and above, while 16.9% earn less than 500US$ a month and could be considered relatively poor. The level of water and electricity consumption depends on affordability, and many Lebanese would struggle to access and consume sufficient amounts of these basic services. The significance of this is that affordability of basic services is a major determinant of social sustainability. In addition the negative effect on heath and well being can also be considered as additional indicators of poverty. The willingness of respondents to commit resources and change attitudes towards adopting energy efficient technologies was also investigated and 74% of respondents answered positively. However, 23.4% answered negatively. There is no doubt that any strategy adopted to encourage sustainable energy consumption has to be affordable.

Finally it is important to note that 74% of respondents are female households and this is probably due to the fact that the questionnaires and related measurement were done between 9.00 a.m. and 2.00 p.m. This is the period that most housewives are present and the rest of the family are out of the

house. In addition, looking at the number of households working full time, 62.3% have one person at work on full time basis, and this is also reflected on monthly income of a households. This gender characteristics of ZM households was tackled by Zalzal (2005; p.6) and argues that it remains one of the main structural barriers to poverty eradication in the country. Zalzal (2005) recommends the following anti-poverty measures:

- Enabling women to enter the productive labour market, thus freeing them from income deprivation

- Creating a supportive family environment through changes in the family code and criminal law

- Supporting women and enabling them to decision making positions.

7.4 Sustainability Awareness and Participation

This section looks at the awareness of the different built environment stakeholders of the concept of sustainable development. Energy efficiency, renewable sources of energy and technologies, waste recycling, natural resource consumption and disposal are some of the issues tackled in the stakeholders' questionnaire. The questionnaire with the inhabitants of ZM, the questionnaire with the built environment professionals, and the semi-structured interview with the vice-president of the ZM municipality, are all primary data that are analyzed to reveal the level of awareness of all stakeholders and their level of participation in sustainable urban management decision-making process.

The results of the semi-structured interview suggest that the rehabilitation of ZM built environment do not follow any structured physical plan and lacked appropriate vision for the present and the future. Most of the developments that are of concern are on the corridor of the main highway linking ZM with the rest of Lebanon. This highway links the coastal west with the eastern mountains opening the Adonis area of ZM for development. This has resulted in the addition of more space to buildings while other infrastructures such as and roads, sewage network, and water supply system are being put in place. These

developments are ongoing with little considerations for their aesthetic and environmental impact. The interview has produced huge insights to the urban development in the area, some of which are positive and others negative.

Among the positive aspects is the idea related to urban greening, however this has been limited to greening roundabout and intersections on the main streets as well as fruit trees along inner streets. It is also positive that some of the industries contacted by the municipality that were required to rehabilitate their facades along the highway, reacted positively. However the problem of industries is not only an aesthetical one but also of environmental pollution in view of the effluents such as toxic wastes, CO_2 emission, and other obnoxious gases discharged into the environment. Furthermore, not all buildings are connected to existing sewage networks and may not be able to accommodate such a deluge of wastes even if these buildings were to be connected. As a consequence, open sewage prevail while sewage stored in deep pits seeps into the water table, resulting in water borne diseases to which infants are most susceptible.

As shown from the interview, the works undertaken by the municipality are mostly superficial; stone-facing municipal streets walls and greening street intersections. The inner residential areas that evolved hap-hazardously, such as the Adonis area are yet to come into consideration for rehabilitation. The problem of domestic solid-waste management is wholly taken for granted with the consequences that no system is in place to tackle solid waste pollution. Last but not least is the problem of public participation. There was no indication from the interview that reveal household's involvement in urban decision making at any stage of the decision making process. The absence of such involvement on the one hand, and household data on the other necessitated the need for primary data gathering collected by the questionnaire.

Question that was asked concerns whether respondents are aware on ways and benefits of reducing energy consumption, such as installing solar heating, energy saving bulbs photovoltaic, applying insulating materials in rehabilitation, and greening. Figure 7.19 show that the majority of the respondents consider

installation of solar heating systems and the use of low energy light bulbs to be the effective ways to reduce energy consumption. When asked whether they would adopt energy saving methods, 74% answered positively while the rest answered negatively. This shows that respondents are aware of the need and the possible ways that energy consumption can be reduced or sustainably managed. However, there is overwhelming indication of their unwillingness to change attitude.

Figure 7.19

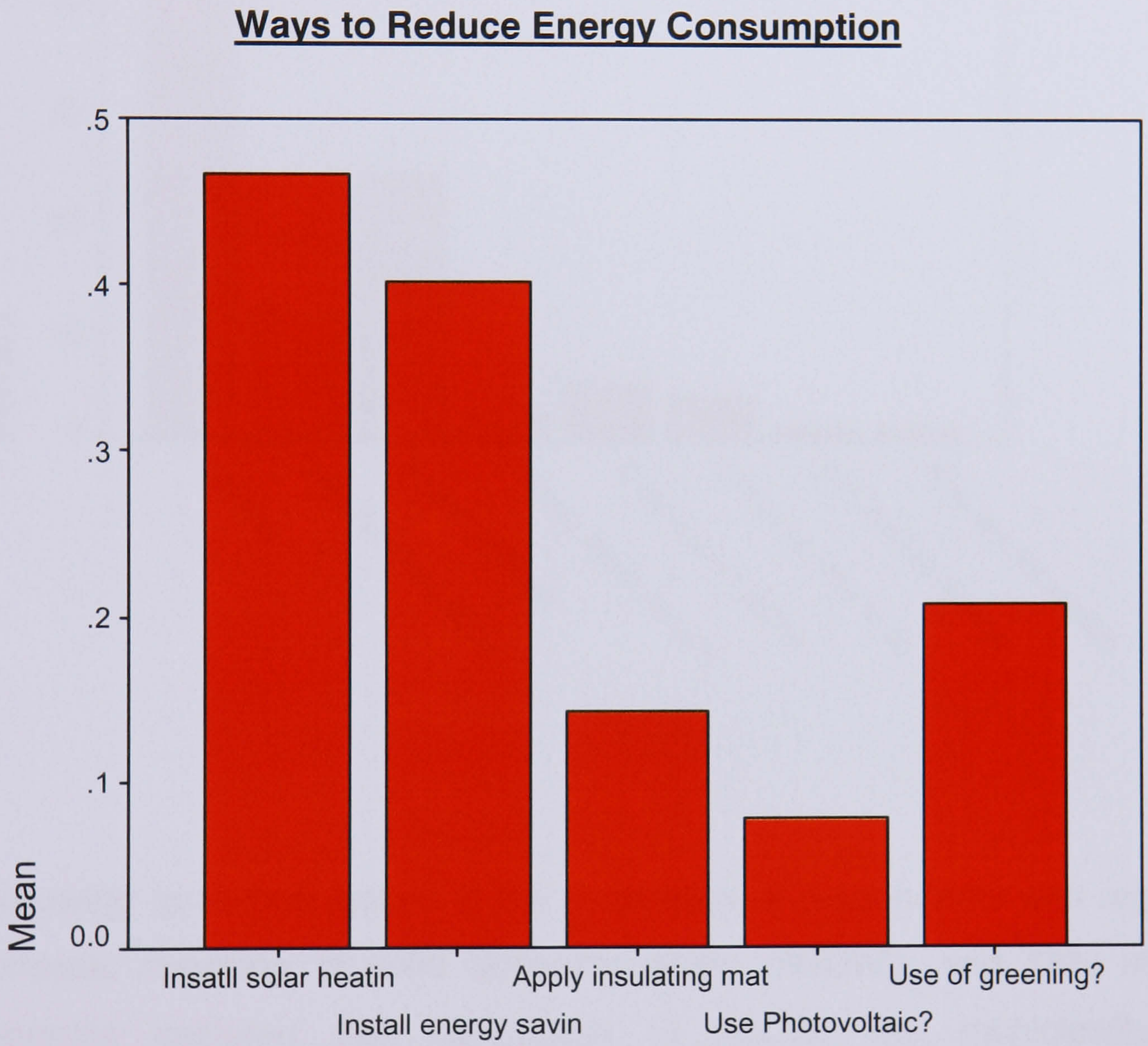
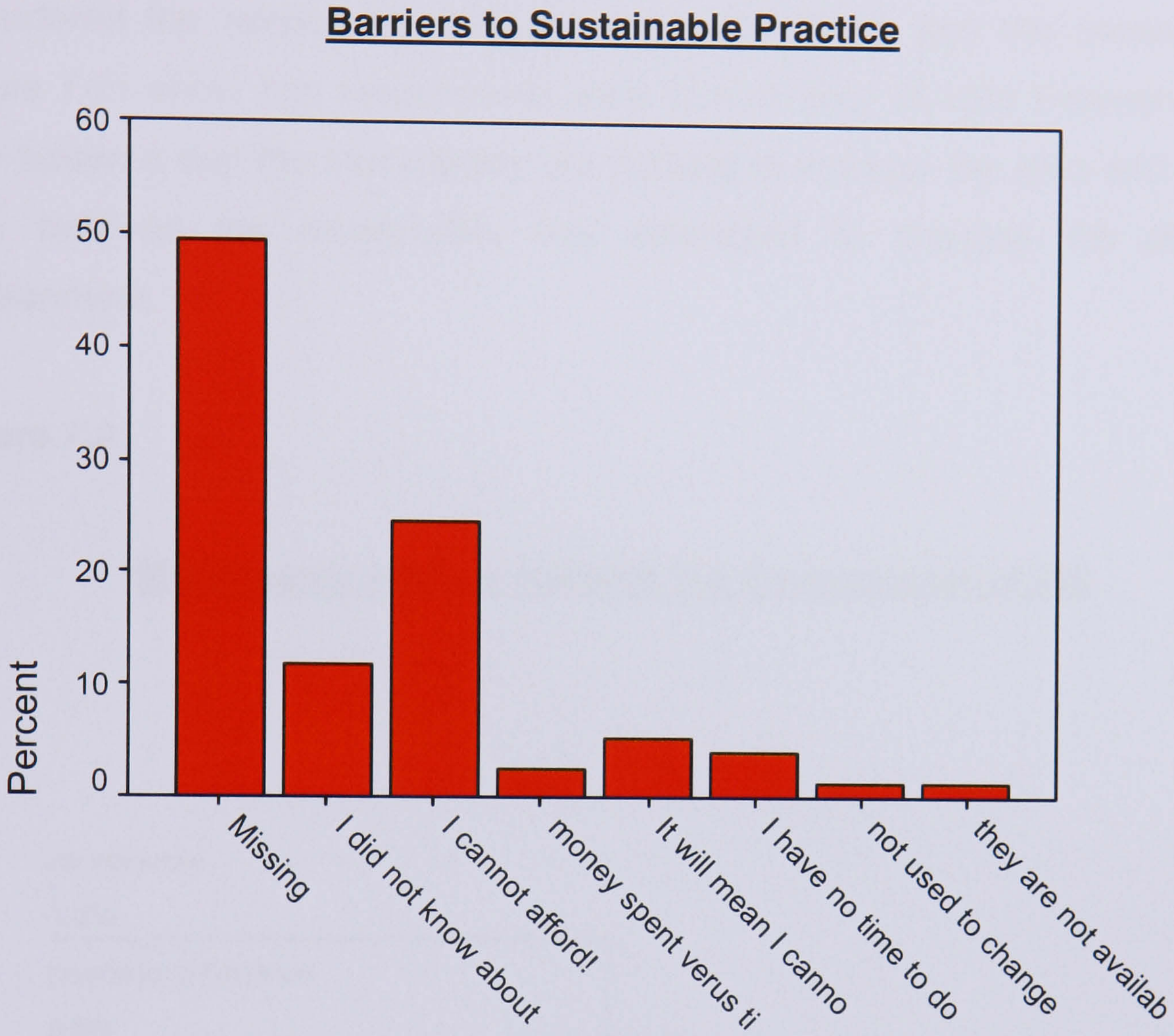


Figure 7.20 presents the different reasons given by respondents for refusing to adopt energy saving measures. Although 50% of the 77 respondents did not answer this question, the 25% that answered suggests that energy conservation as well as other sustainable practices is luxuries. This group simply expressed the view that such measures were unaffordable luxuries, while 12% simply were unaware of such energy conservation measures. The

rest of the respondents simply consider such energy conservation measures as too technically complex and time consuming.

Figure 7.20



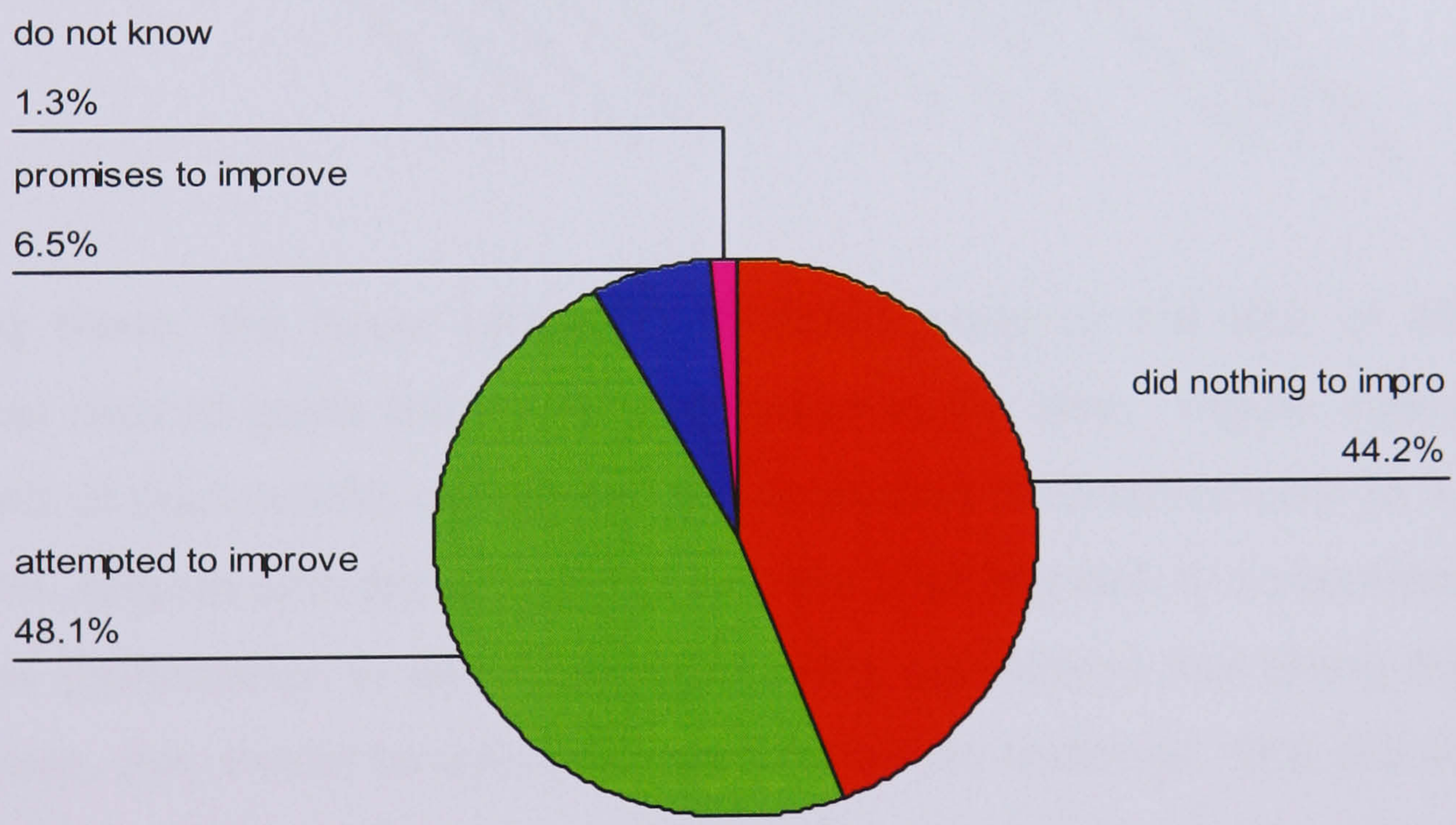
The following questions looked at the awareness of respondents with regards to domestic recycling of solid domestic waste (RSDW)), and 78% of the respondents declared their awareness of RSDW. The municipality, in collaboration with a private company, has agreed to a separated collection of domestic solid-waste (SUKLEEN) where recycling bins are distributed in the area for paper, plastic, glass, and tin. The respondents were asked if they knew about the existence of such a scheme in the area and if they were engaged at the initial setting-up stage. Only 31% of the respondents knew about the existence of recycling bins, even then, they were not consulted prior to distribution, while 84% of the respondents indicated that they were not consulted or informed about the distribution of such facilities. This shows a lack

of effective communication between the municipality and households without whose cooperation sustainable development cannot take root.

The last two questions of section 6 of the questionnaire (appendix 5) considered the relationship between the respondents and the municipality. Figure 7.21 show that respondents were almost fairly divided between those who believed that the municipality did nothing to improve the area and others who believed the municipality has attempted to improve the physical environment.

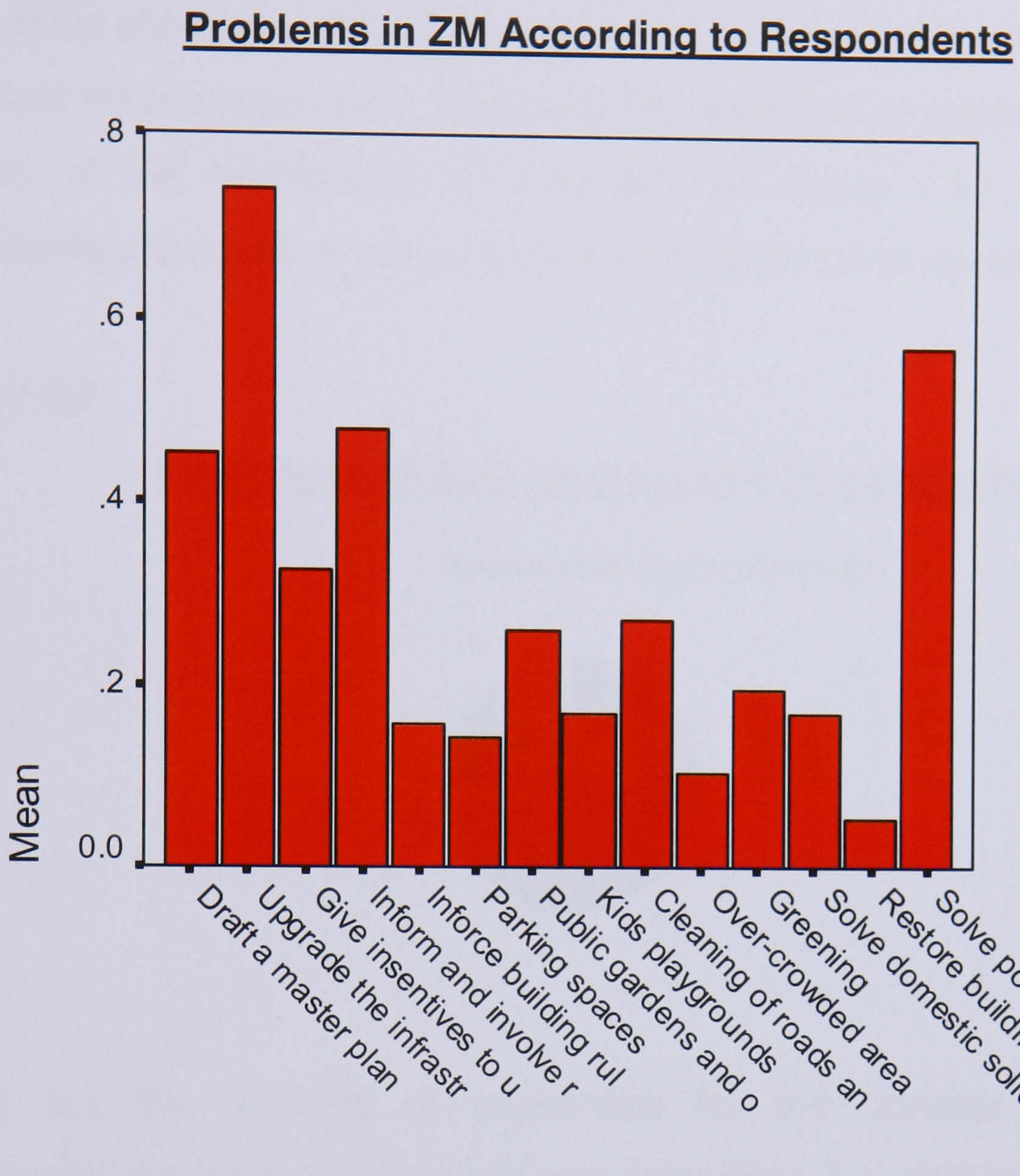
Figure 7.21

Municipality Attitude towards the Development of ZM



Finally an open-ended question was asked to understand the problems, of the area from respondents' perspective and to try and gauge their expectations and perceptions of the municipality of ZM.

Figure 7.22

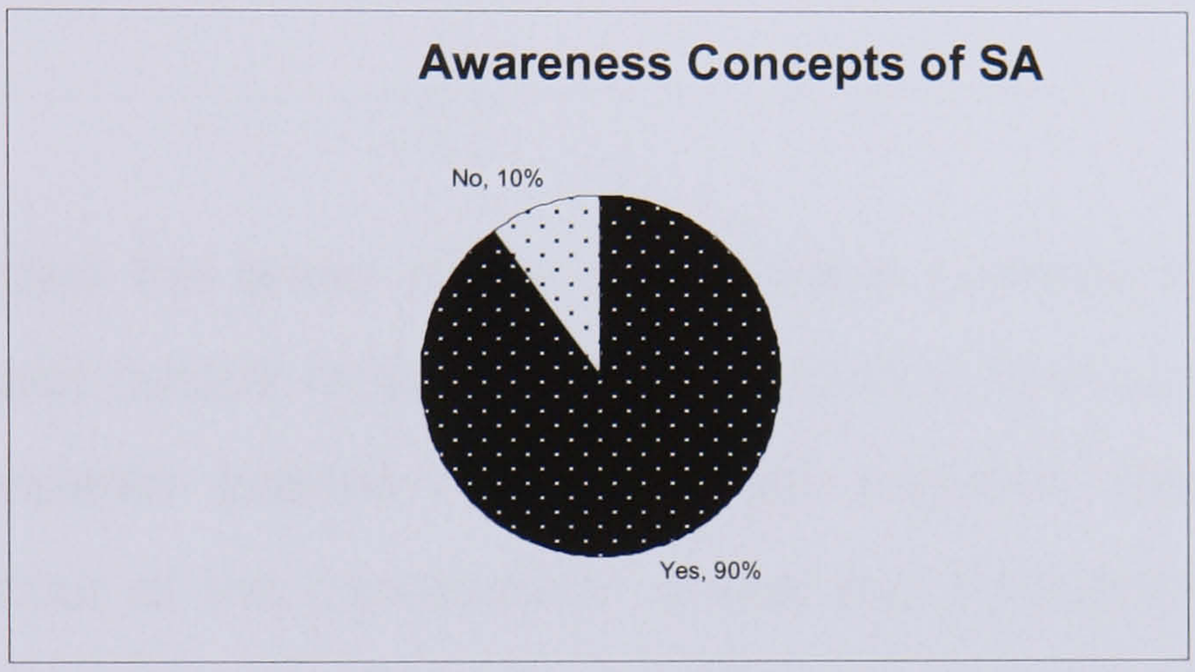


Among these, the major problems identified relate to the lack of effective physical plan to guide the works undertaken in the area. Figure 7.25 shows that 74% of respondents considered the upgrading of infrastructures as a major concern. Around 52% are concerned with the seeming lack of consultation and citizens' participation in decision-making. 68% considered that giving the right incentives, they would be willing to rehabilitate their buildings. 58% placed their emphasis on the energy sector, especially the power plants, which emit polluting particulates endangering to good health. Issues of enforcements and regulations, creation of public spaces for parking, public gardens and urban greening, kids' playgrounds, cleaning of roads and public spaces, were signalled by residents as the most pressing urban issues facing ZM. Others include problems associating with overcrowding, solid domestic wastes, and restoration of war damaged buildings.

The built environment professional's point of view was also sought through a questionnaire which looked at the level of awareness and the extent of sustainable building practice in Lebanon (appendix 4). Almost all of the respondents showed profound awareness of the adverse environmental impact of the built environment form, especially the depletion of natural resources and pollution of the biophysical environment. As figure 7.23 shows, 90% of respondents are aware of the concept and importance of sustainability issues.

Figure 7.23

Awareness of Built Environment Professionals



Finding out the sources of awareness for the concept of sustainable development amongst respondents was important. It is interesting that 50% of respondents learned about the concept of sustainable development in their university education, while the other 50% became aware of the concept from personal interests.

The views of the impact of the built environment on the biophysical environment vary. In figure 7.24, 34% emphasised the impact on natural resource depletion, while 30% emphasised the pollution impact, and 24% dwelled on the impact on human health and comfort.

Figure 7.24

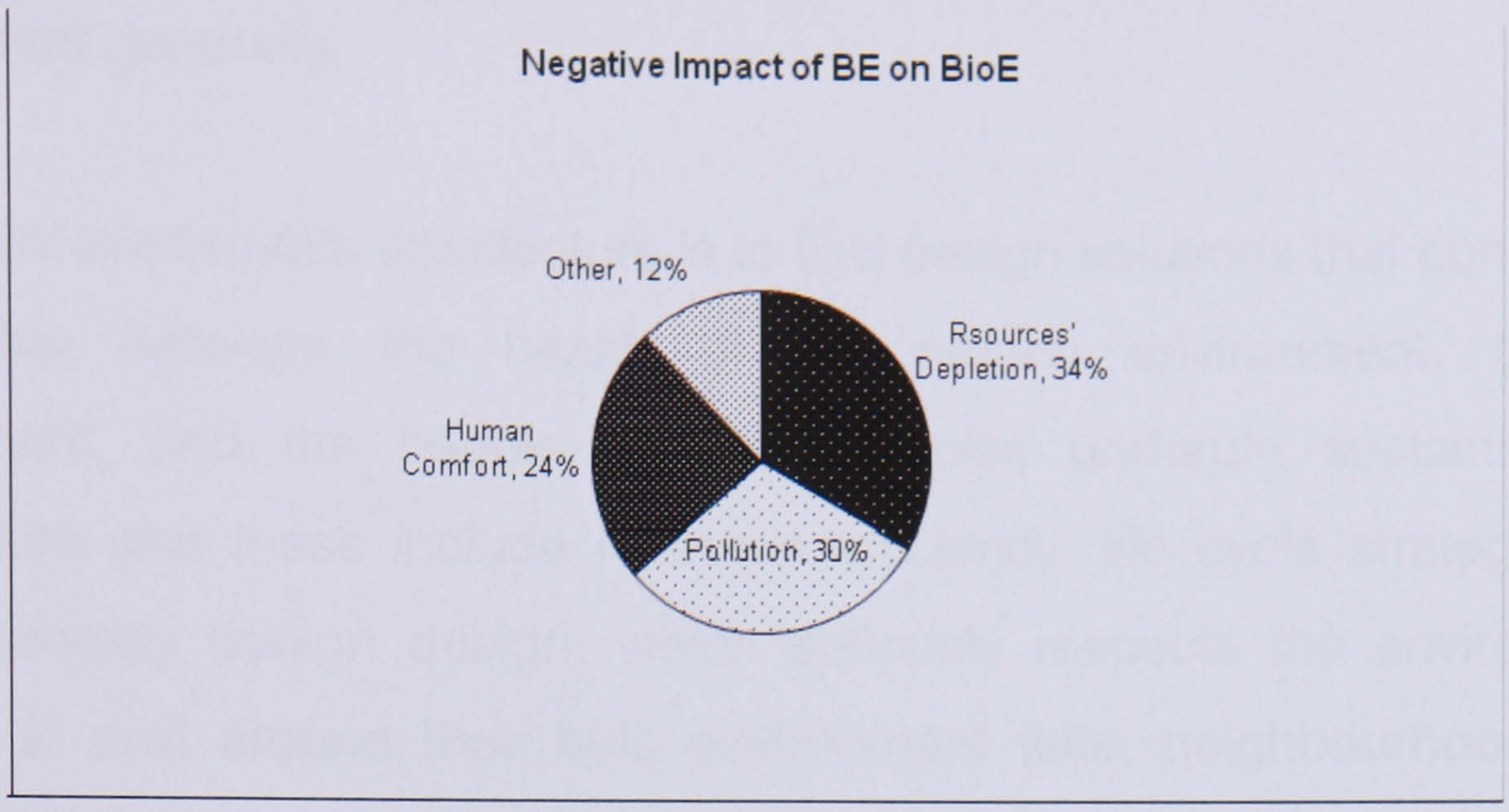
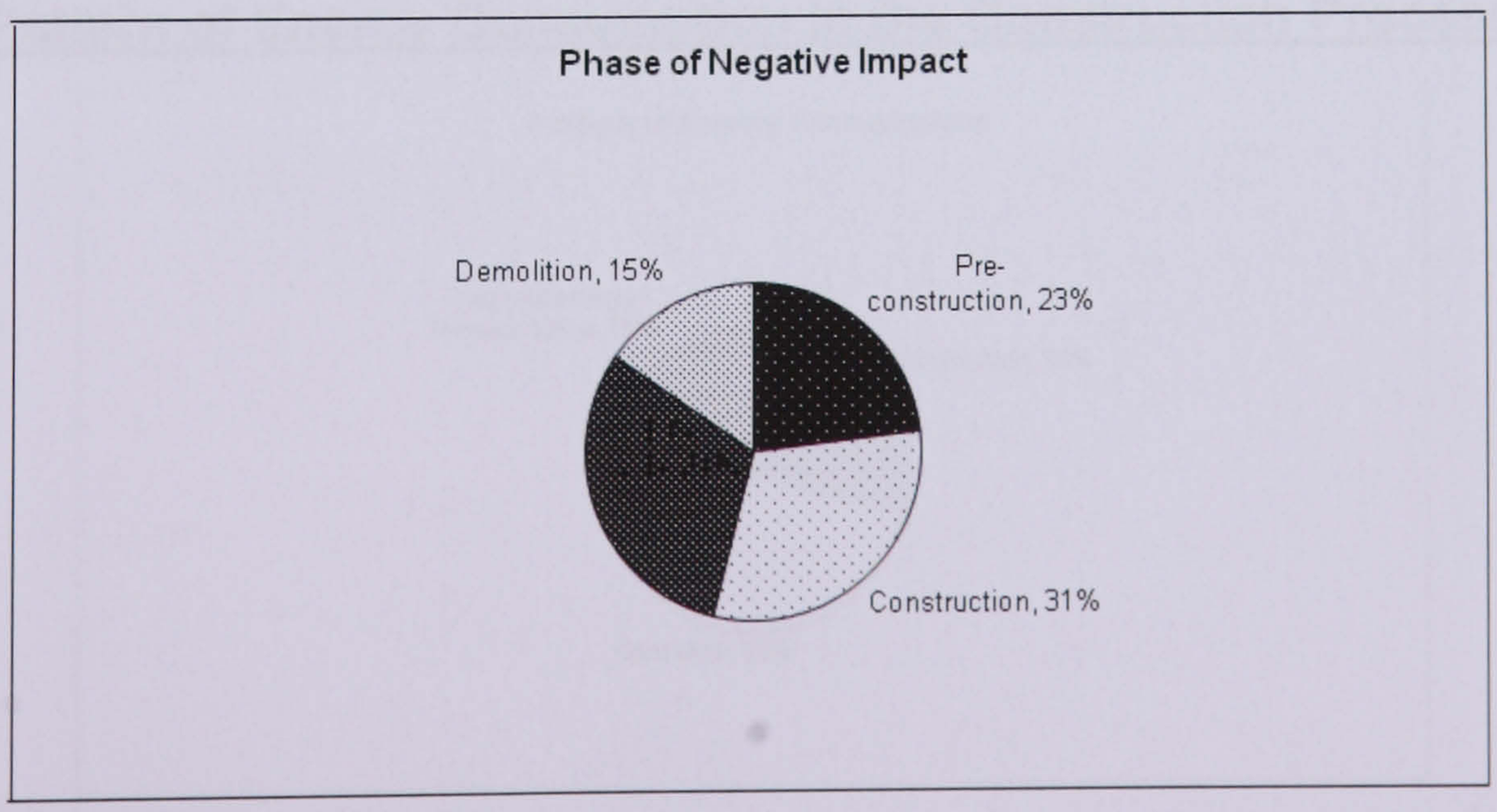


Figure 7.25 shows the areas of the construction process where respondents believe the impact occurs mostly on the biophysical environment. Accordingly, 62% of respondents believe that the most negative impacts of the built environment occur at the construction phase and throughout the life cycle of the construction product. This is significant given that it is possible to proactively intervene at the design stage of construction process to minimise the impact of the built environment on the biophysical environment.

Figure 7.25



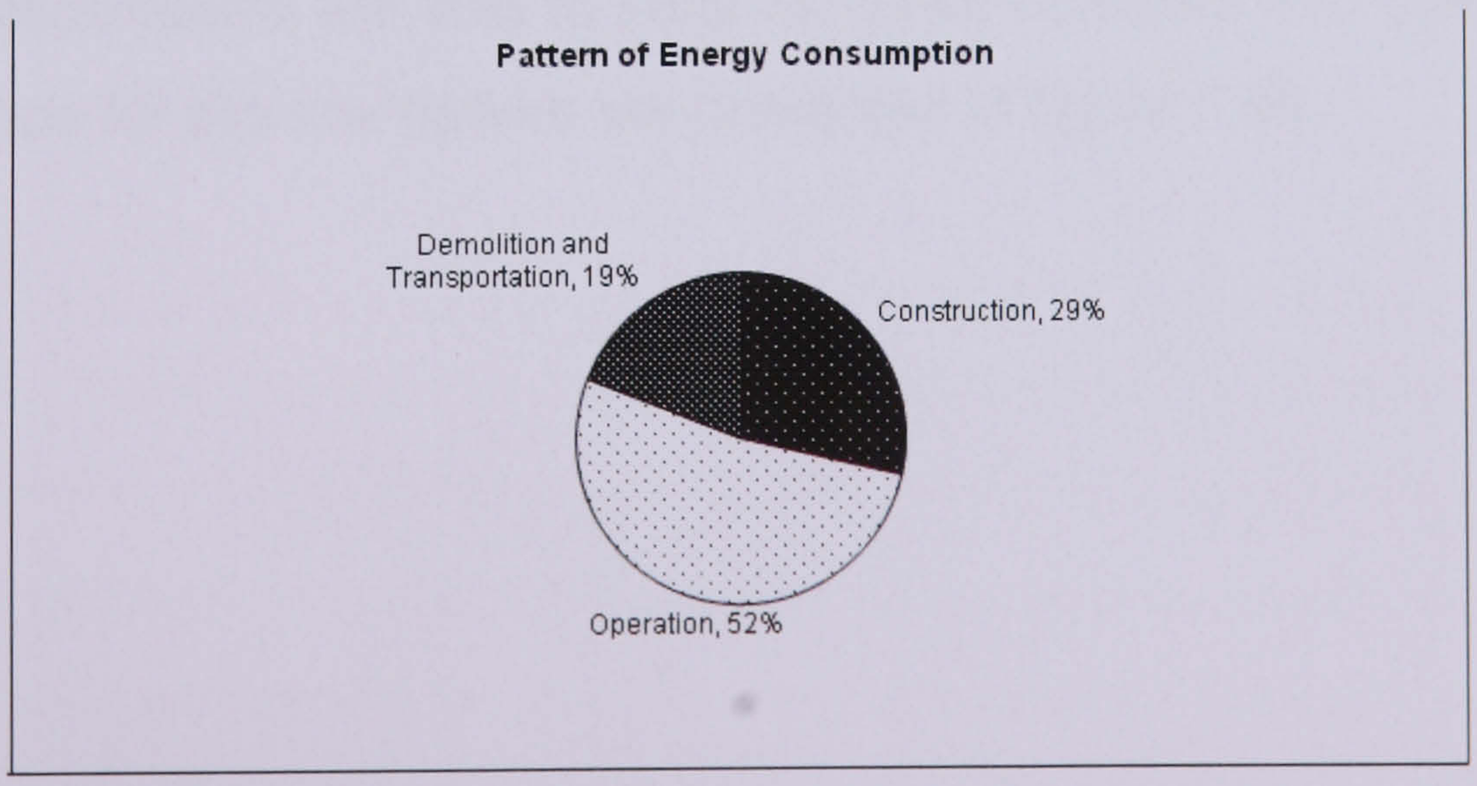
Additionally, construction products designed with a view to sustainability can have significant impact on construction wastes. The realisation of this fact has resulted in huge emphasis on sustainable architecture and sustainable built environment generally.

The goal of sustainable architecture is to find design solutions that consider the relationship between the health of the natural environment, the built environment, and the people. Three principles underpin sustainability in Architecture and these include resource efficiency, life cycle strategies, and environmentally benign design, which seriously respects the environmental qualities in and around their built environment (site, neighbourhood, cities, regions, etc.), and ensuring human comfort. Sustainable architecture has the potential to minimise the huge demolition wastes from the sector. This is particularly the case where buildings can be designed and built such that they can easily be demolished and their components recycled and reused.

Similarly, the response to the question on energy consumption is instructive on respondents' perception of areas of resource intensity in the construction process. As figure 7.26 shows, more than half of total energy consumed in the built environment occurs at the post construction stage used for enhancing the functionality of construction products and output.

Figure 7.26

Pattern of Energy Consumption in the Construction Process

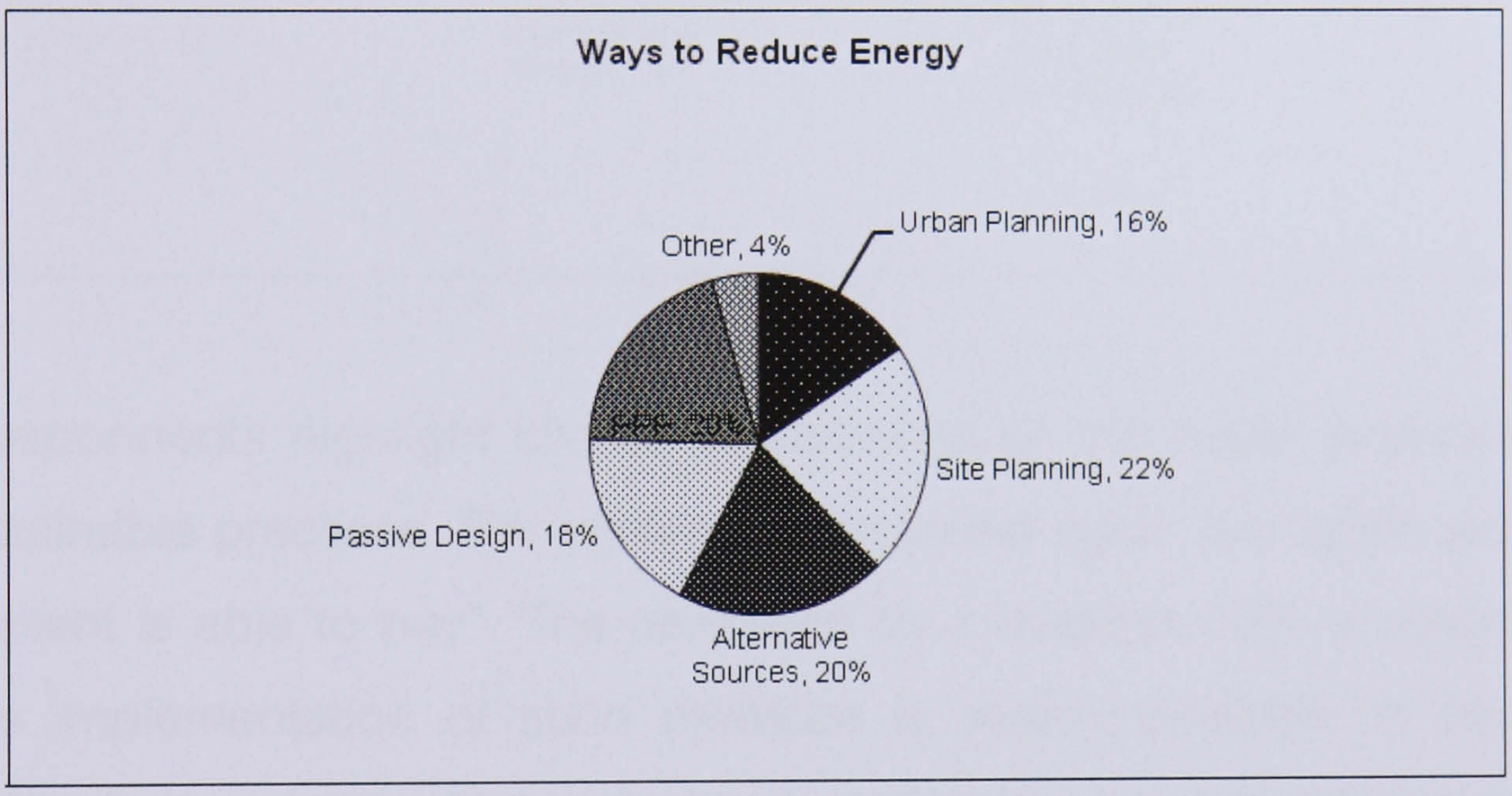


However, the scope for reducing resource consumption in the built environment is huge, especially when buildings are designed to consume minimum energy and other non-renewable natural resources inputs.

As figure 7.27 shows, this point is explicitly made by respondents that energy use in the built environment can be significantly reduced through better site planning, designs incorporating alternative material use, passive designs, and recycling, reusing and rehabilitating.

Figure 7.27

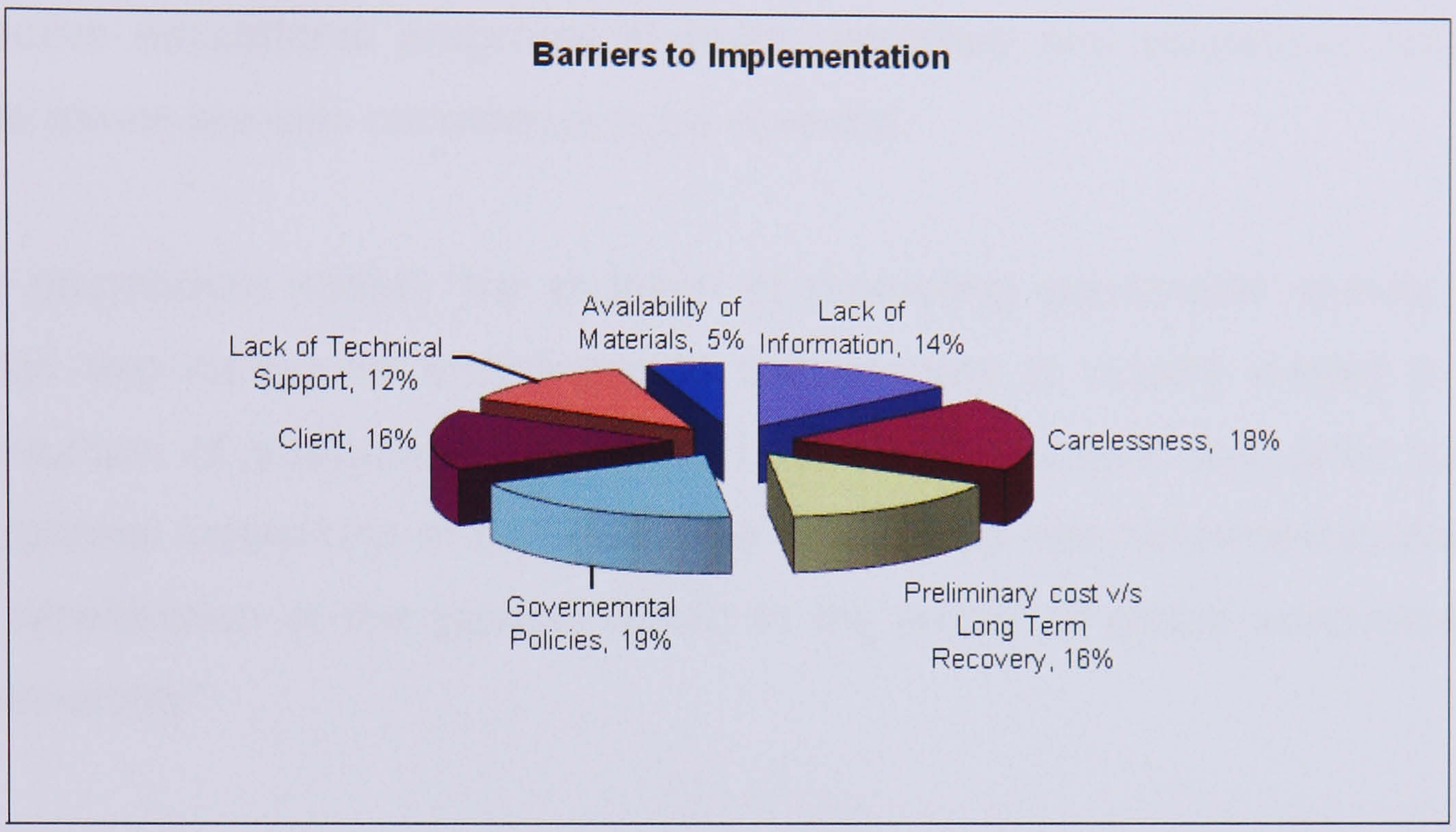
Ways to Reduce Energy Consumption



However, despite the profound awareness of the concept of sustainability by built environment professionals in Lebanon, it would be important to know why only 36% respondents are able to translate these concepts into projects. Some of the reasons for this low uptake are presented in figure 7.28.

Figure 7.28

Barriers to Sustainable Architectural Design



Most respondents highlight clients' preferences as the major explanation for low sustainable practices. The sentiments repeated again and again are one of "if the client is able to pay". The revelation by a massive 82% of respondents that the implementation of such measure is mainly possible in private by funded projects and in some cases in regionally or internationally funded projects emphasises the importance placed by built environment practitioners meeting clients' needs. The message is that built environment practitioners can only provide what clients want, indicating that educating clients on the significance and importance of global environmental sustainability is vitally important.

Nevertheless, other constraints identified include lack of governmental policies to enforce and implement sustainable development. Similarly, lack of information, education, training, and technical support in addition to the lack of expressed interest from clients due to the preliminary cost are some of the other reasons given.

When asked whether, as built environment professionals, they would change their attitudes and approaches towards sustainability, 100% of our respondents responded positively. However, 90% agreed that building rules and standards coupled with economic incentives are necessary to encourage both built environment professionals and clients to adopt sustainable measures. Proactive educational programs to build capacities and awareness towards these issues are also considered to be essential.

One respondent added "the problem of promoting sustainable architectural design and caring for environmental sustainability is closely related to the introduction of sustainability curricula in schools, colleges and other higher educational institutions in Lebanon. The media also has fundamental roles in the sensitisation of the general public to the issues of global environmental sustainability".

The analysis of the data gathered from the stakeholders shows a huge difference in opinion and perception between citizens and decision makers. It also shows a fair level of awareness at the different levels. However the gaps existing between all the stakeholders were revealed and show lack of communication and exchange between all of them. In addition, the types of answers and requests made by the respondents on the one hand, and the area of priority for the municipality attests to this conflict of interest between citizens and municipality officials. Effective participation by all stakeholders holds the effective means of bridging such differences. Such cooperation would certainly help to define problems, set priorities for action, and definitely improve the quality of life of people in the area of ZM.

CHAPTER 8

Summary and Recommendations

8.1 Introduction

This chapter summarises the findings and offers recommendations for the sustainable rehabilitation of the built environment in the coastal area of Zouk Mosbeh. It seeks to answer the main research questions raised in the thesis and provide recommendations for the ZM coastal area, which could be widely applied to other areas of the Lebanese Coastal Zone (LCZ) with similar characteristics. In this regard, a general conclusion followed by a precise chart-synopsis of the contribution to knowledge by mapping the framework (table 8.1), evidence, and attendant sources.

8.2 Sustainable Rehabilitation of ZM: Recommendations and Guidelines

The rapid and unplanned growth of the coastal area of ZM resulted in a number of serious environmental and social problems. Environmental deterioration had a negative impact on living conditions at the local geographical scale and at the regional and global scale. High consumption levels of non-renewable resources such as energy and water consumption, and very high pollution rates, especially of water and air, was the result of rapid growth of population and development within an originally rural type of settlement. One major result of the inadequate transformation of a rural area into an urban settlement was inappropriate land-use. The negative effects of the current situation on the urban atmosphere and of the reduction and pollution of urban water supply lead to very high health risks and infectious diseases (Nadakavukaren, 2000, and Republic of Lebanon, 2001).

To avoid huge correctional expenditure in the future, principles of sustainable urban development should inform the behavioural all stakeholders involved in the built environment in the area of ZM. The solutions will have to take into consideration the well being of the natural environment, the strength of the built

environment, and the health of the people living in this environment. Resource efficiency, life-cycle strategies, and sustainable designs, are necessary imperatives to achieving environmental sustainability. This is only possible when all stakeholders commit to the principles of sustainable built environment where physical development is pursued holistically so as to embrace the economic, social and environmental dimensions of sustainability.

However, this is only possible if there is a change of attitude among all stakeholders in the pursuit of sustainable development and would require the full participation of all stakeholders and must be encouraged by local and national governmental authorities if it is to be successful. Nevertheless, a participatory bottom-up approach to development would ensure that policies are not top-down resulting in a lack of responsibility wherein no one takes ownership of the programme. Each member of the community will have to be aware of their individual and collective responsibilities as well as rights, and of the responsibility and rights of all the others.

8.2.1. Planning and legal framework

It is clear from the literature that the different stages of the built environment can have negative impact on the natural environment. These include all the stages of the construction process, including the extraction of raw materials for construction, site excavation, and the building process itself. This process affects all the environmental media of air, land, and sea. The existing bulk of buildings in the area of ZM embody huge amounts of energy and environmental capital, it is therefore unthinkable to demolish all existing buildings, it is recommended, rather, that these buildings be rehabilitated within a general rehabilitation plan of ZM municipal area.

A holistic and direct approach to the different problems of the environment will have to be envisaged. The solutions will have to follow a process that considers the issue of management and strategic planning, and a legal framework that takes into consideration the different scales of intervention, especially at the national, regional, and local levels.

At the national level, the Lebanese Government has committed itself to implementing Agenda 21. The lack of effective law, regulations and directives pertaining to sustainable development, in particular, and to Agenda 21 specifically shows the urgent need on the part of the government to facilitate the development of appropriate and necessary institutions to effect sustainable development policies. The Lebanese National Master Plan (LNMP), undertaken by the Government of Lebanon through the Council for Development and Reconstruction (CDR), and still waiting approval, considers, among other issues, that territorial management should take into consideration the unity and the territorial integrity of the country.

Similarly, an equitable development of the different regions and the sustainable exploitation of the natural resources, especially water should be given priority. This would amount to a positive change in the right direction if it is fully implemented, since local governments will need to draft their development and rehabilitation strategies to adhere to the general guidelines of the LNMP. Although the LNMP attempt to consider a sustainable approach to physical development, it does not provide clear directives and solutions for the rehabilitation of the existing deteriorated built environment. Accordingly, it will be necessary at the local level to develop local development and rehabilitation strategies following detailed surveys and assessments in each area.

However, the scales of intervention will have to consider current land-use patterns in the three main areas of ZM, including the old centre or ZM town, the residential expansions from the centre, and the industrial areas.

Old ZM centre (appendix 8, sectors 5 and 6): the data analysis has shown that the local government (municipality) is undertaking important works of street embellishment and rehabilitation, as well as infrastructure maintenance. New medium-rise buildings are still being constructed, even though the area is saturated with buildings, and lacks green open spaces and kids' playgrounds (Questionnaire with residents, Interviews with Municipality, Appendix 7). It is important to preserve the few existing traditional houses, and allow for more

open public green spaces and playgrounds for children in addition to the only one existing public garden in the area.

The main area of expansion in ZM is the residential area of Adonis. Here, too, many medium-rise buildings are still being constructed although the area is hugely saturated and lacking parking spaces, green open spaces, and kids' playgrounds (questionnaire with residents, interview with Municipality vice-president, and appendix 7). It is recommended that a general rehabilitation plan of existing buildings should be embraced. The plan will have to consider the economic, social and environmental dimensions of sustainability. Indeed, this would require:

A full survey and assessment of the existing buildings, their distribution, and their micro-climatic qualities will have to be conducted. This will have to consider the structural and especially the technological performance of the buildings, their proximity to one another, and the amount of open green space around these buildings.

Greening through the use of different species of deciduous and evergreen ramping plants, or trees would result in a low-cost intervention and in a significant improvement in air quality and temperature. More shade and evapotranspiration will decrease the reliance on mechanical means of heating and cooling, and will improve the aesthetics of the building itself and the area in general.

Repairing and replacing deteriorated enclosure walls of buildings would decrease the leakage of rain water into the buildings and energy loss, as well as decrease energy costs and consumption due to mechanical heating and cooling. It will also positively affect the aesthetic value of the buildings. Replacing, single glazed windows with double glazing and aluminium profiles incorporating thermal brake devices, could be considered. However, this should take into consideration the energy and environmental pollution embodied in these products. The introduction of appropriately designed shading devices would also decrease the amount of mean radiant temperature

and glare, reducing, therefore, greenhouse effect and excessive heating caused by direct sunlight hitting on windows.

Replacing incandescent light bulbs with energy efficient bulbs inside houses will also decrease energy consumption and consequently energy bills. All of this would allow people to rely more on passive strategies than on mechanical means for heating and cooling, reducing electricity consumption, which confers obvious benefits on the environment.

However, due to the high direct costs of such interventions, there is the need for innovations regarding strategies of implementation and enforcement. These strategies will have to include environmental awareness, and economic campaigns. In addition, improving life quality would actually decrease relative poverty level.

Following the survey and assessment, a cost-benefit study for rehabilitation costs on each building will have to be conducted. The study might reveal unsustainable economic rehabilitation costs in some buildings. In this case, since the rehabilitation costs would be much higher than the costs of demolition and rebuild, rebuilding is recommended. This will also contribute to the quality of the environment and society if rebuilding is done with cognisance to environmental sustainability. These buildings might be demolished and replaced by new buildings or by open green and public spaces. In such cases, expropriation of the land might be considered and appropriate indemnities will have to be paid by the local government.

The negative impact on air and water of industrial areas upon residential areas in ZM and of both air and water on its environment in general has been clearly analysed and identified. In addition, the LNMP has also invited major environmental risks due to industrial zones: fire risks, explosions, and spills of hazardous solid or liquid wastes. It accordingly recommends a perimeter of security where housing is not allowed to be incorporated in the urban master plans.

However, in cases where such housing already exists it has been recommended that further residential growth should be stopped. In ZM, housing has expanded to directly face the two industrial areas, and this expansion has not stopped yet. Mitigation measures will have to be undertaken to improve the living conditions. These will have to include measures to minimize air pollutants and noise production, as well as controlling on water pollution. Although many of the necessary measures have already been identified by those responsible for the different industrial sectors, lack of implementation is still a main problem.

Shifting from gas to methane in the Zouk Mikael power plant for electric generation would decrease air pollution. The use of filters, electrostatic precipitators, scrubbers, and inertial collectors would reduce dry particulates in the air as well as removing liquid droplets. The use of appropriate absorption and condenser devices would remove gaseous pollutant, and the adoption of odours conversion techniques would reduce noxious odours. The improvement in the power network and proper management of the company would also decrease the hours of power cuts, reducing the need for environmentally unsustainable generators which currently use fuel oil a huge cost.

Also, the observations undertaken on site have shown industrial areas are located topographically in the lower parts of ZM close to residential areas. Around the industrial area there are still significant empty lots. A practical implementation of the LNMP recommendations would be to transform these particular green spaces into permanent greenbelt of parks and open spaces around the industrial and residential areas. Landownership will have to be considered in such case, and expropriation would have to be undertaken and appropriate indemnities paid to the owners.

Noise reduction measures could take different forms; the time, time span, and days of working period and construction activities should be clearly set. Noise reduction devices could be installed in industries and targeted at electric generators and other sources of noise.

Water consumption and disposal from industrial activity could be improved. Pre-treating industrial waste water prior to its disposal in appropriate sewage network, or, if possible, recycling it for reuse would help reduce waste enhance clean water supply. It will be necessary, in accordance with the LNMP, to design and build appropriate water treatment plants within the coastal zone. This will also allow residential water waste to be discharged and treated appropriately. For example, the stone processing factories in the coastal zone could be mandated or encouraged to recycle and reuse water. Similarly, textile factories are intensive water users and could also be subjected to regimes of recycling and reuse of water to minimise waste.

The problem of domestic and industrial solid waste should be given the desired attention and cooperation should be sought from all stakeholders. Regulations coupled with incentives and awareness campaigns should be targeted at industries and stakeholders to facilitate the recycling and reuse of solid waste. Hazardous waste must be appropriately treated in specialized places or directly on site. However, it must be emphasised that incentives and encouragement, only, will probably not be enough; the municipality may have to enact laws enforcing solid waste management. The municipality must also make citizens aware of its activities and their responsibility regarding its environmental policies and strategy. This can be done through massive awareness campaigns. Although the possibility of relocating some industries might be very expensive, it should nevertheless be considered as an option within the municipal rehabilitation strategies.

Before the mid fifties, ZM and other rural areas relied mainly on agriculture. Today, tourist and leisure attractions are progressively overtaking agriculture as the main source of employment. This has resulted in the growth of residential and commercial developments as shown in Appendix 8 which clearly shows increased tourist and leisure facilities along the western part of ZM Mediterranean Sea Coast as well as the Nahr el Kalb valley. This expansion should be seriously considered within the rehabilitation strategies for its negative impacts on the coastal environment and heavy demands on water

resources. In particular, the building of private beachfront resorts should be discouraged and the beachfront rehabilitated and made accessible to the general public. Indeed the vast majority of these structures were illegally built during the civil war sealing off public access.

Apart from aesthetic pollution, these structures do significant impact on the marine ecology, especially as household wastes and effluence are dumped into the sea untreated. However, the municipality has to be proactive. For example, no serious work on the sewage infrastructure has been done or planned and a significant part of the residential areas is yet to be considered for rehabilitation. Also, no effective pressure seemed to have been applied to industries to change attitude and behaviour towards resisting the implementing of the municipality's environmentally friendly policies,

8.2.2. Roles and responsibilities of stakeholders in ZM

The stakeholders involved in the physical development of ZM built environment are mainly the municipality, the inhabitants and built environment professionals such as, architects, engineers, developers, and construction companies.

The municipality is responsible for planning and implementing rules and regulations within the area and in accordance with the general guidelines set by the LNMP. It is clear from the data analysis that the approach of the municipality does not always follow any development plans, but an ad-hoc approach where evidence of public participation in decision making and policy formulation is paltry.

As made clear from the analysis majority of the inhabitants of ZM, though subject to taxation for the maintenance of infrastructures, are not originally from this area of Lebanon, and according to the Lebanese laws, do not have the right to vote in municipal elections. This makes accountability impossible and allows the municipality to concentrate its development works within a very small and limited area aimed at pleasing the original inhabitants (appendix 7). It was also clear from the data analysis that there are huge differences in opinion and perception between citizens and decision makers.

The analysis has revealed that built environment professionals have shown interest and awareness of sustainable architecture. However, very few of them implement and reflect such interests and desires in their projects and, according to them, this is due to various barriers such as clients' wishes , lack of established rules and regulations as well as incentives.

Thus, a very close collaboration between all stakeholders through a bottom-up approach to planning will allow the effective and equitable use of available resources through the mobilization of the community and its resources. This presents the most effective strategy of improving the quality of the physical environment, enhancing services, and improving social conditions in ZM. This requires all stakeholders to will be made inclusive and welcome in order to take ownership of sustainable initiatives.

The first step towards enhancing community spirit is ensuring transparency and accountability and this can be done by affording equal rights to all the citizens of ZM irrespective of their towns of origin. This is necessary to allow effective participatory development strategy for the area where all stakeholders can contribute to policy formulation and implementation.

However, this will only succeed with adequate institutional capacities and programs including education and awareness campaigns by which stakeholders are informed and their cooperation solicited. Institutionally, transparency and accountability on the part of the government on the one hand, and on the other, the rights of citizens must be institutionalised in the constitution for sustainable rehabilitation of Lebanon to be meaningful. A summary of the contribution made by this study to existing knowledge is presented in Table 8.1

Table 8.1

Synopsis: Contribution to Knowledge

Framework	Evidence	Source
Planning Agenda • *Old Centre*: preservation of the few traditional houses, and of the traditional core. Freeze the construction of Medium-Rise Buildings. Expropriation of empty lots for public open spaces. • *Expansion Areas:* Adonis area is saturated with buildings. Expropriation of empty lots for public open spaces. • *Industrial Areas:* Treatment of solid and water waste disposal, and causes of pollution. Development of a green belt dividing between residential and industrial areas on empty lots around industrial area. • *Tourist Areas:* Enforce law prohibiting building on public domains. Force existing resorts to adopt appropriate technologies for waste-water treatment. • *Agricultural Areas*: Preservation of agricultural land through economic incentives by municipality.	• Deterioration of old structures, and encroachment of the new structures on the older ones. This has negatively affected privacy, and thermal comfort. • Sufficient number of empty residential buildings and apartments versus demands and needs, and lack of green public spaces and kids playgrounds. • Negative impact of industrial pollution on health and wellbeing of the inhabitants. Negative impact on natural environment due to solid waste and waste water disposal. • Barrier to public maritime domain. Water waste disposal into the sea. However, good economic revenue to the municipality through taxes. • Enhancing green areas, and positive economic revenue to both private and public sectors in the area.	• Site observation (appendix 8) • Interview with Vice-president of the Municipality • Appendix 7 • Reports and statistics from Republic of Lebanon 1997, 1998, 2001, 2002, 2003, and 2004a, b.
Public Realm • Develop landscape design project of the empty areas surrounding industrial zone (appendix 8, sector 4). Including coastal agriculture and public gardens. • Develop public open green spaces in empty lots between residential buildings, including underground parking and kids' playgrounds. • Include inner streets and roundabouts to cover all the areas of ZM in the embellishment and greening projects undertaken by the	• Thermal indoor and outdoor comfort in the area is undermined by the lack of greening. • Greening enhances air quality and cooling trough shading and evapotranspiration. • The lack of community activities, kids' playgrounds, parking, impacts negatively on belonging. • Unbalanced development between the different areas of ZM, between inhabitants originally from ZM and new inhabitants.	• Questionnaire and survey undertaken with inhabitants and municipality. • Site observation (appendix 8). • Aerial photography and land-use map. • Urban Design literature. • Sustainable Development literature.

municipality.		
Energy Consumption • Rehabilitation of deteriorated external walls, connection between walls and windows to prevent water leaking to the interior spaces and energy loss. • Waterproofing horizontal roofs, rehabilitation of water drainage patterns and paving with light materials to protect waterproofing and enhance sunrays reflection. • Planting vines and other deciduous ramping plants to the south-western elevations would reduce temperature in summer through shading and cooling by Evapotranspiration. In addition deciduous plants would enhance solar heating in winter.	• Dissatisfaction with thermal sensation in winter and summer. • Excessive reliance on mechanical means for cooling and heating. • Energy loss in heating and cooling due to buildings' orientation, deterioration of buildings' skin, thickness and material used in buildings' skin and roof system.	• Site observation. • Energy consumption reports. • Survey and estimation of respondent's thermal satisfaction. • Passive and low energy Architecture literature. • Green and sustainable Architecture literature. • Bioclimatic Architecture literature • Learning from vernacular or traditional architecture.
Vernacular Building Studies • Building cavity walls instead of single layered walls. • Using rigid insulation above waterproof membranes, and paving with light coloured materials. • Plant deciduous trees, vines and/or other plants to enhance thermal comfort, and allow ventilating indoors to benefit from cross ventilation especially in humid coastal areas. Plants will also decrease heat by shading. Introduce were possible shading external devices instead of internal curtains or blinds to avoid green house effect created by solar radiation on windows.	• To achieve the qualities of thermal mass walls. • To achieve the thermal qualities of vernacular earth roof. • Vines and deciduous trees were planted to the south-western sides of vernacular architecture, shading inner areas and enhancing thermal comfort. In addition, cross-ventilation was secured through the openings on four sides.	• Ongoing researches at Notre Dame University, in Lebanon, in other local Universities, and in Europe and USA, on Passive and Low Energy Architecture • Passive and low energy architecture literature. • Vernacular Architecture Literature.
Economics of rehabilitation and new build • Benefits of rehabilitation versus new build. Redevelopment is considered much more expensive than rehabilitation; Scope for reuse and recycle of materials, use of local materials and savings on transportation. However	• Local materials and skills availability • Life cycle assessment (building process from cradle to grave) of buildings would allow evaluating whether to rehabilitate or to rebuild. • Existing buildings were built with lower standards. The costs of upgrading	• Reports and statistics from Republic of Lebanon 1998, 2002, 2004 a, and 2004b • Appendix 7 • Economics and built environment literature.

new build may have longer life and provide relatively modern quality accommodation. • Sustainable techniques • Time scales	may be such as to suggest that it is not economic to rehabilitate and to demolish the building entirely.	
Residents • Participation should not be limited to information, but to active involvement of all the residents in urban development the decision making process. • Capacity buildings of all stakeholders would guarantee appropriate bottom-up approach. • Infrastructures' development will have to take into consideration all the municipal areas of ZM to achieve equity between residents.	• In the area of ZM around 2000 residents are originally from the area, and have the right to vote, while an approximate number of 20000 inhabitant come from other Lebanese regions • The questionnaire and survey has shown reciprocal fear between municipality and residents to discuss and decide upon development strategies. • Apart from the works undertaken in sector six and along the main road crossing the southern edge of ZM, the other sectors are left with no development and rehabilitation of infrastructures.	• Site observation • Aerial maps and photography • Interview with Vice-president of the Municipality • Appendix 7

8.3 Conclusion

This research has established the negative impact that the built environment is having on the Biophysical environment of the Lebanese Coastal Zone (LCZ). The major source of the pressure exerted on the LCZ derives from the huge upsurge in building, which has much to do with the cessation of hostilities after fifteen years of civil-war (1975-1990). The war brought with it huge political instability, disrupted existing institutions and institution building capacity, displacement of people, and ushered in a regime of unplanned and uncontrolled development. The consequences have manifested in huge environmental pollution and urban decay.

Thus, the hypothesis of the research was that unplanned and unregulated developments in the LCZ constitutes a major source of environmental pollution and degradation which cannot be sustained because of the huge opportunities

being missed to map a clear sustainable development path for Lebanon. The work undertaken for this research clearly shows that environmental sustainability in the LCZ is severely undermined by unplanned and unregulated physical development. It is clear from the research that while spatial planning has been largely taken for granted in Lebanon, the physical development that has occurred since the civil-war has accentuated Lebanon's chaotic urban development pattern. This pattern is more pronounced along the LCZ with huge negative impact on the bio-physical environment.

The continuing local and regional instabilities are also having a huge impact on the environment and on the capacity of the local and regional administrations as well as stakeholders to plan, decide and implement sustainable development. The idea of decentralization of powers from central government to regional and local authorities introduced at the end of hostilities in 1990 should be taken seriously and implemented as a strategy of bringing the government closer to the people.

However, effective development and decentralization would entail economic empowerment and capacity building. In addition, a clear hierarchical structure of urban centres and growth zones related to southern, central and northern coastal areas should be developed. Metropolitan Beirut and its southern and northern secondary expansions would have to be considered as one region, due to their direct geographical proximity and share of infrastructure and services. The same approach could be applied to the southern metropolis of Sidon and adjacent areas.

The LNMP should consider the concept of sustainable community and seek to preserve the traditional economic, social and environmental character of the rural areas LCZ. This would preserve their unique historical characteristics while at the same time the capacity of the local economy in providing employment opportunities. While accepting that upgrading is inevitable owing to population pressure but this should be done in ways and manners that enhances rather than diminishes the integrity of traditional buildings. Such

rehabilitation plans should only be allowed under strict rules and regulations to stem the rapid disappearance of traditional buildings in ZM.

In general, to achieve sustainability in the rehabilitation of the built environment, of ZM, there has to be a tacit collaboration and understanding between the stakeholders. The Lebanese Government should seriously consider sustainable development as an integral part of its socio-economic and political strategy. In the particular case of the built environment, changing attitudes and steering households and businesses away from non-renewable natural resources should be given serious consideration.

The National Thermal Standard (Republic of Lebanon, 2003) should be implemented and incorporated into within the building rules and regulations. However, stakeholders will have to be informed, educated, and encouraged towards the adoption these standards and regulations, and generally the wider concept of sustainability and development.

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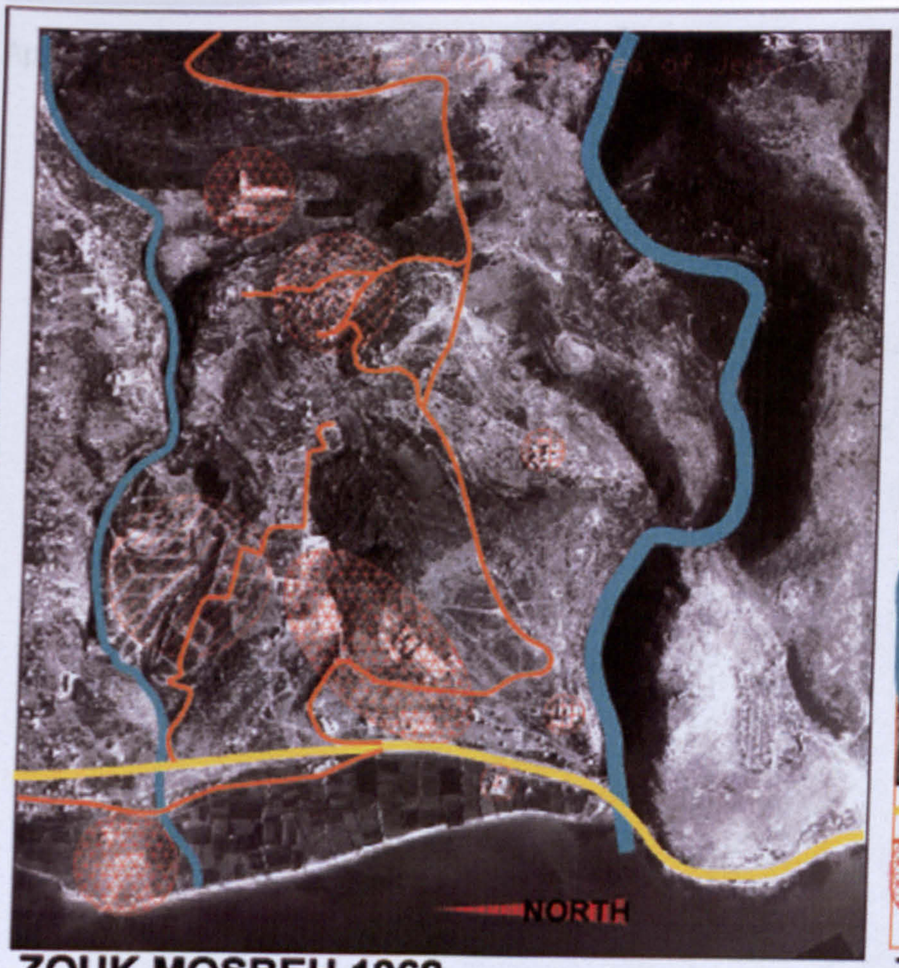
Appendix I

The maps chosen for this report are indicative and are copied from the following website: http://www.lib.utexas.edu/maps/lebanon.html

Lebanon (shaded relief 2002)

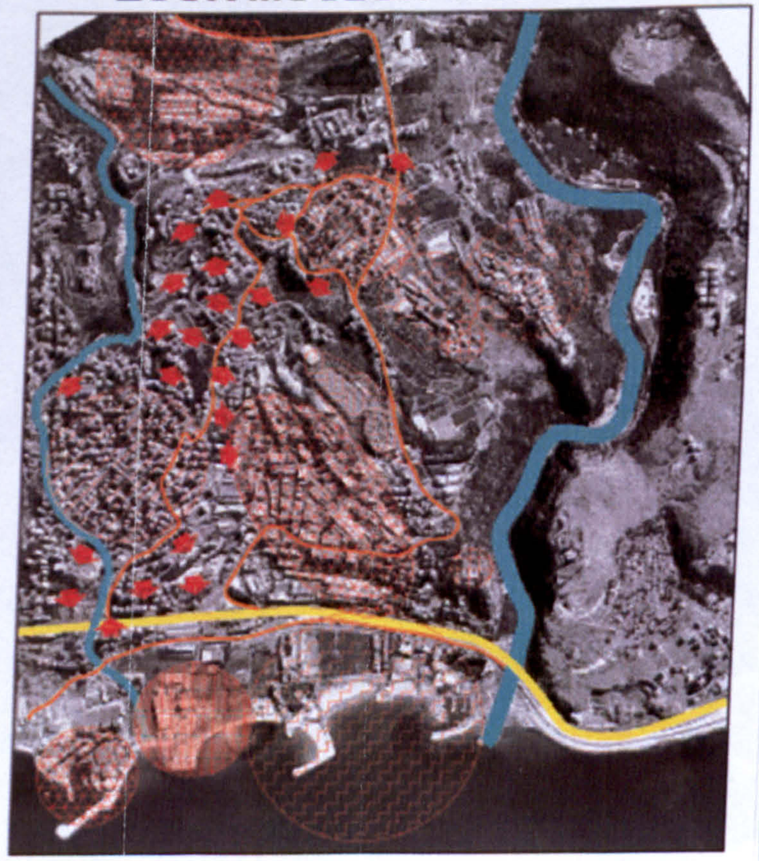
Appendix 2



ZOUK MOSBEH 1962

ZOUK MOSBEH 1968

ZOUK MOSBEH 1998



ZOUK MOSBEH 2001

DYNAMIC DEVELOPMENT

- Bodies of water (limiting of ZM from North and South)
- Main Highway (limiting ZM from the east)
- Main roads through ZM (link between main areas in ZM)
- Residential area of Adonis
- Industrial areas
- Religious areas
- Electric power plant
- Tourist summer resorts
- Cultural (university and school)
- Leisure (ice skating, carting, etc.)
- Expansion of residential areas

The area of Zouk Mosbeh is approximately 4kmsq.

1962: The rural area of ZM in the beginnings of its growth
The highway linking the South of Lebanon to the North, exists wide enough to encounter present density of vehicular circulation.
Secondary roads are developed to serve new emerging residential areas (i.e. Adonis), as well as existing industrial areas.
Old houses are spread in the old town of ZM, as well as in the rest of the area. These are reached through non aspahlted pedestrian paths.
Green areas in the forms of pine forests, and terraced agricultural lands (olive trees, fruit trees, vineyards, etc.).

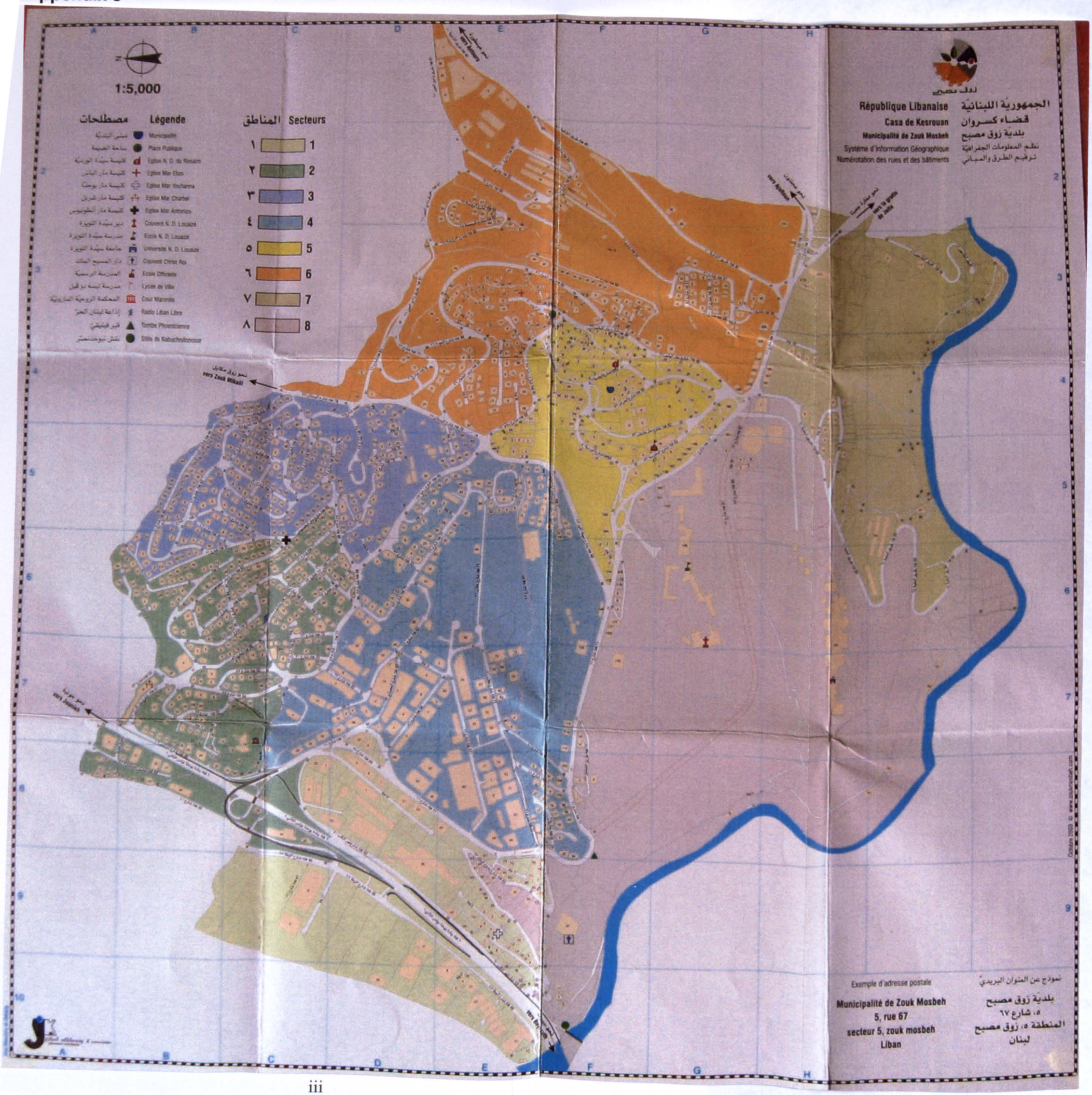
1968: The features of the rural town still exist.
An imprtant number of pedestrain paths are transformed into main roads (due to the constrcution of new buildings).
New landuses emerge such as touristic (on the agricultural coastal areas and cultural (school).

1998/2001: The rural town is transformed into a city-like developement.
Highway is widened to bear the higher density of vehicular circulation.
More paths are transformed into main roads, in addtion to a secondary network of streets.
Residential, industrial, tourist, commercial, cultural, and recreational areas over-expand in all directions, the area becoming therefore highly urbanized.
Ribbon development along the highway, mixed industrial, commercial and residential area.

SOURCE OF BASE AERIAL PHOTOS:
Lebanese Republic, Lebanese Army
Direction of Geographic Affairs

AERIAL PHOTOS OF YEARS: 1962, 1968, 1998, 200

Appendix 3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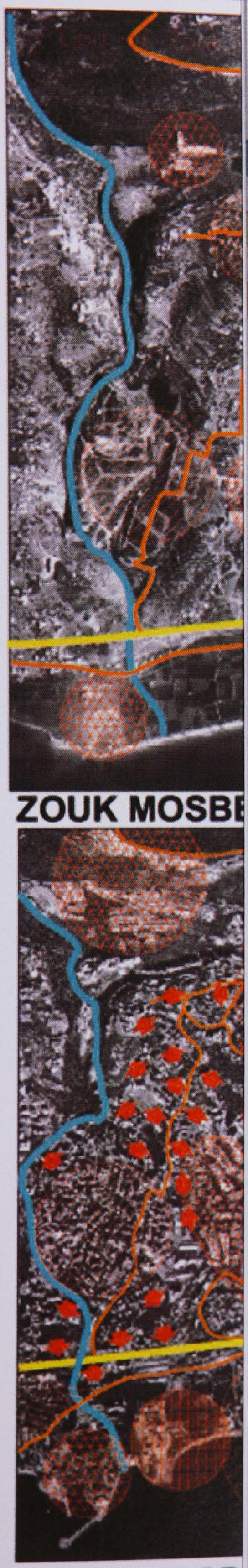
مصطلحات
Légende
المناطق
Secteurs
République Libanaise
الجمهورية اللبنانية
Casa de Kesrouan
قضاء كسروان
Municipalité de Zouk Mosbeh
بلدية زوق مصبح
Système d'information Géographique
نظم المعلومات الجغرافية
Numérotation des rues et des bâtiments
ترقيم الطرق والمباني
vers Antélias
vers Zouk Mikaël
vers Jounieh
vers le pont de Jdita
Exemple d'adresse postale
Municipalité de Zouk Mosbeh
5, rue 67
secteur 5, zouk mosbeh
Liban
نموذج عن العنوان البريدي
بلدية زوق مصبح
٥، شارع ٦٧
المنطقة ٥، زوق مصبح
لبنان

Appendix 2



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- Main roads through ZM (link between main areas in ZM)
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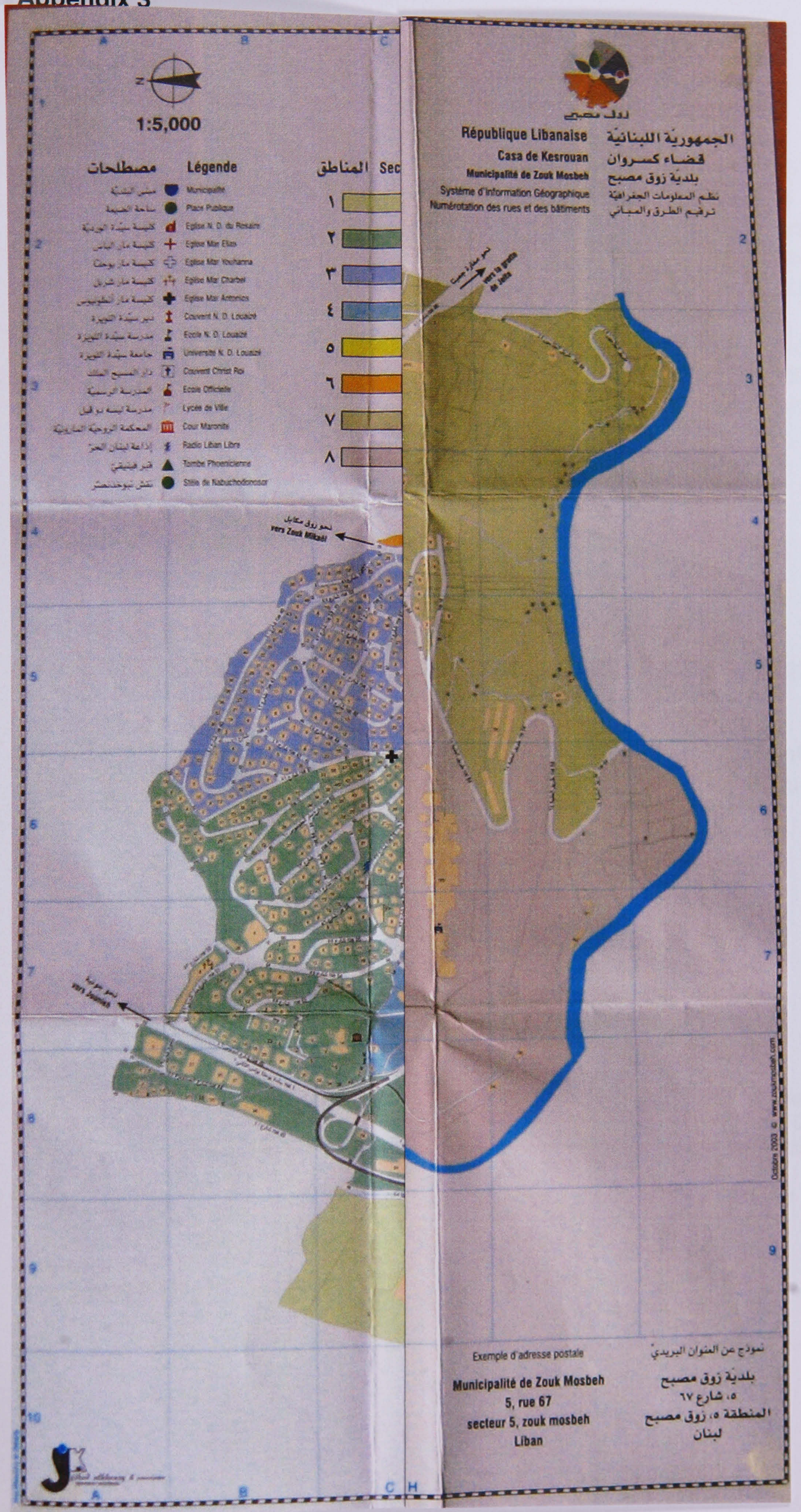
1:5,000
Légende
مصطلحات
المناطق
Municipalité
Place Publique
Eglise N. D. du Rosaire
Eglise Mar Elias
Eglise Mar Youhanna
Eglise Mar Charbel
Eglise Mar Antonios
Couvent N. D. Louaizé
Ecole N. D. Louaizé
Université N. D. Louaizé
Couvent Christ Roi
Ecole Officielle
Lycée de Ville
Cour Maronite
Radio Liban Libre
Tombe Phénicienne
Stèle de Nabuchodonosor
vers Zouk Mikaël
vers Jbeil
Jbeil
Zouk Mosbeh
Zouk Mikaël
Jbeil
Septembre 2003 © www.zoukmosbeh.com
Exemple d'adresse postale
Municipalité de Zouk Mosbeh
5, rue 67
secteur 5, zouk mosbeh
Liban
نموذج عن العنوان البريدي
بلدية زوق مصبح
٥، شارع ٦٧
المنطقة ٥، زوق مصبح
لبنان

Appendix 4

QUESTIONNAIRE

I am Senior Lecturer in the Faculty of Architecture Art and Design (FAAD), at the Notre Dame University (NDU, and a PhD student at the De Montfort University, Faculty of Art and Design, Leicester School of Architecture, Leicester, United Kingdom. The paper I am writing is to be presented at the international conference on Passive and Low Energy Architecture (PLEA 2005) in November 2005 hosted by NDU.

This questionnaire is designed to help me in the ongoing research looking at the topic: "Sustainability and the Built Environment: Changing Attitudes in Lebanon". The ultimate objective of this research is to contribute and inform on the built environment and sustainability debates in Lebanon.

The questions from sections 1- 5 will tackle the following information:

1. Background
2. Environmental sensibility (impact of built environment on the bio-physical environment)
3. Sustainability and awareness (what and how?)
4. Barriers towards changing attitude
5. Personal opinions on strategies to change attitude and approaches towards sustainability in architecture

Note that you and/or your firm have been chosen randomly. All information provided will be treated in the strictest confidence. Please would you fill in the questions below ticking the appropriate box relevant to your case?

Thank you for participating.

.....

Jean-Pierre El Asmar
Notre Dame University
Faculty of Architecture Art and Design
Department of Architecture
Zouk Mosbeh
72 Zouk Mikael
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De Montfort University
Faculty of Art and Design
School of Architecture
The Gateway
Leicester LE1 9BH

Sustainability is not intended as a nostalgic return to the past, and is not by any mean to bring to an end of evolution, avoiding taking action and living passively to decrease the depletion of natural resources. It rather looks to the past to learn from it. It is a holistic approach based on the adoption of design and construction methods and materials that are resources efficient, and that will not compromise the health of the environment and the well-being of building occupants in meeting their needs and future generations to meet their needs.

The goal of sustainable architecture is to find design solutions that consider the relationship between the health of the natural environment, the health of the built environment and the health of the people living in this environment.

Three principles would lead to sustainability in Architecture:

1. Resource efficiency: this relates to the economy of resources (energy, water, and materials) through the reduction, the reuse and the recycling of the natural resources that are used in the building process.

2. Life cycle strategies: relating the building process (before, during and after construction) to its impact on the biophysical environment.

3. Responsible design: design that seriously respects the environmental quality in and around their built environment (site, neighbourhood, cities, regions, etc.), and ensuring human comfort.

Section 1: Background

1. Name (optional)
2. Age
    a. 20 – 35 □
    b. 36 – 45 □
    c. 46 – 55 □
    d. 56 and above
3. Firm, company, group, (optional)
4. City, town
5. Affiliation according to the Order of Engineers and Architects
    a. Architect(s) □
    b. Engineer(s) □
    c. Contractor □
    d. Other (please specify)
6. Order of Engineers and Architects or Syndicate
    a. Beirut □
    b. Tripoli □
    c. Other (please specify)
7. Type of projects (past and present)
    a. Residential □
    b. Commercial □

c. Cultural □
d. Other (please specify)

8. Category of projects
   a. New □
   b. Renovation □
   c. Other (please specify)
9. Type of client
   a. Public □
   b. Private □
10. Email Address:

Section 2: Environmental sensibility (impact of Built environment on the bio-physical environment)

1. Are you aware of the negative impact of the built environment (BE) on the biophysical environment (BioE)?
   a. Yes □
   b. No (please go to section 3)
2. In what form you think it is manifested?
   a. Depletion of natural resources □
   b. Pollution of natural environment □
   c. Deterioration of human comfort □
   d. Other (please specify)
3. At whish phase the negative impacts of the BE on the BioE happens?
   a. Pre-construction phase □
   b. During construction phase □
   c. During the life of the building □
   d. Demolition phase □
   e. Other (please specify)
4. Are you familiar with the concepts and methods of sustainable architecture?
   a. Yes □
   b. No □
5. If yes, how did you learn about the issues of sustainability pertaining to architecture?
   a. University □
   b. Media information □
   c. Personal interest □
   d. Clients' interest □
   e. Other (please specify)
6. To what extent are you able to conceptualize and design your project from a sustainable approach?
   a. Every project □
   b. Most projects □
   c. Few projects □
   d. Never □
7. In which type of project do you incorporate sustainability?
   a. Public funded projects □
   b. Private funded projects □

c. Other (please specify)

Section 3: Sustainability and awareness (what and how?)

1. What are the sources of energy and water consumption and pollution related to the life cycle of a building?
   a. Energy used for construction for harvesting, processing, transportation, of building materials ☐
   b. Energy and water used for operation (heating, cooling, lighting, rainwater, grey-water, etc.) ☐
   c. Site drainage and landscaping ☐
   d. Energy used for demolition and transportation ☐
   e. Other (please specify)
2. Can you think of ways to reduce water and energy consumption and environmental pollution?
   a. Urban planning (reducing transportation) ☐
   b. Site planning (orientation in relation to sun and wind, landscaping, etc.) ☐
   c. Alternative sources of energy ☐
   d. Passive heating and passive cooling strategies (alternative technologies and lessons from the past) ☐
   e. Reuse, rehabilitate, recycle (buildings, materials, rainwater collection, gray water collection) ☐
   f. Other (please specify)

Section 4: Barriers towards changing attitude

1. Do you know about people in your profession incorporating sustainability in their projects?
   a. Yes ☐
   b. No ☐
   c. Don't know ☐
2. What do you think are the barriers?
   a. Lack of information, education, training, and awareness in relation to sustainable design ☐
   b. Lack of governmental policies enforcing such approach ☐
   c. Lack of expressed interest from clients ☐
   d. Carelessness in relation to environmental issues ☐
   e. Problems related to the preliminary cost behind the adoption of sustainable technologies with respect to long term recovery ☐
   f. Problems related to time management ☐
   g. Lack of understanding and technical support (contractors, craftsmanship, team, etc.) ☐
   h. Materials, products, and technological systems and assistance are not available in Lebanon ☐
   i. Other (please specify)

Section 5: Personal opinions on strategies to change attitude and approaches towards sustainability in architecture

1. Would you start adopting sustainable design concepts in your future projects?
    a. Yes ☐
    b. No ☐
    c. Don't know ☐
2. What of sort of new policies or program would attract you to get more involved in adopting sustainable design approach into your future projects?
    a. Building rules and regulation coupled with economic incentives ☐
    b. Educational programs ☐
    c. Sustainable design standards and guidelines ☐
    d. Other (please specify)
3. Under the above programs and policies would you kindly expand giving additional suggestions?

Appendix 5

Sustainability: changing attitudes in Lebanon

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ABSTRACT

According to several multilateral, unilateral and governmental organizations, the global environment has come under unprecedented pressure, and as a consequence, its 'carrying capacity' is over extended and undermined. The source of this pressure has been traced to the incessant pursuit of economic growth and development, which is seen as necessary to satisfy exorbitant lifestyles lived in the developed countries on the one hand, and on the other, to alleviate pervasive and persistent poverty in the developing world. The impact of such insatiable and continuing demands on the global environment has manifested in high rates of deforestation, increased rates of desertification, highly variable global patterns, which carry huge costs in human and financial terms in relation to frequent global natural disasters. The contribution of the built environment to global environmental deterioration is well established. More than 75 percent of the known factors impacting on the global environment are traceable in one form or the other to the built environment. The land we build, the construction materials consumed, pre and post construction energy and water consumption, the chemical and gas emissions associated with building materials processing, and construction wastes are cases in point. While the first and second waves of global strategy for sustainable development focussed on possible technological solutions, the relevance of winning the hearts and minds of the global community through changing attitudes is gaining grounds as an effective strategy for achieving global environmental sustainability. This paper which derives from the ongoing research effort at De Montfort University in the UK looking at issues relating to sustainable built environment in the coastal areas of Lebanon is an attempt to contribute to current ongoing debate on global sustainability. It is hoped that this paper and indeed the whole of the research will contribute significantly to current debates on environmental sustainability in Lebanon, especially during this period of unprecedented physical reconstruction and development that the principles of sustainable development are observed to avoid huge correctional expenditure in the future.

Conference Topic: Reflections on Sustainability
Keywords: Sustainability, Built Environment, Changing Attitudes, and Adaptation

INTRODUCTION

It was the Bruntland Report (WCED, 1987) that etched the state of the global environment in the consciousness of mankind. The report documented the impact of mankind's insatiable quest for social economic growth and development on the rapidly depleting global resources. Although the concept of sustainable development is variously interpreted and understood by different stakeholders, the definition and understanding sought by Bruntland is employed as a working definition in this paper. This definition is nevertheless useful given its emphasis on the inter and intra generational equity in global resource consumption, requiring the effective management of growth. The Bruntland Report states that *"... development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* constitutes sustainable development (WCED, 1987).

Thus, sustainable development depicts *"a process of change in which exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance current and future potential to meet human needs and aspirations"* (WCED, 1987). The report highlighted three fundamental components of sustainable development, which includes environmental sustainability, economic sustainability, and social sustainability. This is significant given the emphasis on economic and social sustainability, which means that social and economic solutions are just as important as technological solutions to global environmental sustainability.

It is an understatement to say that the development models implemented by majority of countries are seriously biased in favour of economic growth over the carrying-capacity of the biophysical environment, and the welfare and general wellbeing of society, which are often assumed as given. Thus, the 'carrying-capacity' of the global biophysical environment, which is defined, by its ability to replenish itself, has come under enormous threats (Sundquist, 2000).

These threats derive from the huge and often insatiable demands by mankind, which can only be sustained at huge costs, some of which have manifested in enormous and irreversible damage to the biophysical environment.

However, it has been argued that a significant proportion of the factors responsible for global environmental deterioration is traceable in one way or another to the built environment (Ebohon, 1996). This paper will focus on the concept of sustainability within the built environment with particular emphasis on issues of natural resources use. Thus, how to minimise construction materials, construction wastes, and the attendant pollution during and after the construction periods remains the focus of this paper. However, this is not going to be possible without changing perceptions and attitudes of all the stakeholders.

In Lebanon, the desire for sustainable development is overwhelming, especially given the huge demands for infrastructure, housing, and conspicuous consumption that were suppressed during the civil war but are now being unleashed at the end of the war. Twenty years of civil war and regional tension has altered the physical, economic, and social structure and characteristics of Lebanon. Buildings are springing up rapidly, including residential, commercial, and industrial properties with little attention to planning and development controls. Lingering war sentiments and the spirit of reconciliation can only explain this reluctance of the government to enforce planning and development.

However, there is the real possibility that when such culture is entrenched, it would be very difficult to reverse. The problem is how persuade the government, construction industry practitioners, and other stakeholders that building to plan, standards, and development controls holds the key to sustainable development of Lebanon. Thus, it is imperative to first ascertain the current awareness of the issues and essence of sustainable development by construction industry practitioners in Lebanon.

THEORETICAL FRAMEWORK

The process of sustainable development requires us all to think carefully about what, how, and why we use environmental resources the way we do. Our current practice has caused immense global concerns because of the acceleration in global resource depletion (UN, 2002), which is particularly the case with those global resources that are non-renewable. Some of the manifestations of our activities include rapid ozone depletion, growing deforestation, the green house effect, and global warming (IPCC, 2000).

The theoretical proposition is that sustainable construction, which embody all such activities in the construction sector as architectural design, house building, and property management presents an opportunity to counter the deteriorating global environmental trends (Ebohon, 1997, Ebohon et.al 2001). That the built environment has a great impact on the natural environment is not in dispute owing to the amount of renewable and non renewable natural resource inputs to the building process, which starts with excavation and production of building materials to the construction and demolition of buildings. For example, it is estimated that:

- 50% of all global resources go into construction activities
- 45% of global energy generated is used to heat, light and ventilate buildings and 5% to construct them
- 40% of water used globally is for sanitation and other uses in buildings
- 60% of prime agricultural land lost to farming is used for building purposes
- 70% of global timber products end up in building construction

Similarly, construction products, according to Edwards et al. (2002) have long lives and embody enormous environmental capital. This is aptly illustrated in Table 1, with the implication that proactive sustainable building design surely enhances environmental, social and economic sustainability of construction output. It also serves to minimise the impact of physical development on the biophysical environment.

Table1 Typical lives of different aspects of construction

Source: Edwards et al. (2002)

CONSTRUCTION ACTIVITIES	LONGIVITY
• Building services	20 years
• Buildings	50+ years
• Infrastructure (roads, railways)	100+ years
• Cities	500+ years

LEBANON

The case of Lebanon is instructive where, as previously explained, years of local and regional conflicts have stocked up demands for housing and other conspicuous consumption. The end of hostilities has witnessed unprecedented growth and development, especially in the built environment sector. The impact of the built environment (BE) on the physical environment is evident and fast approaching a crisis level (Government of Lebanon, CDR, 1997). This is particularly the case given that over 75 percent of the Lebanese population and economic activity are concentrated in the coastal zone, which is less than 16% of the country's geographical area but contributes about 73 percent of Lebanon's GDP.

The Lebanese coastal zone (LCZ) although endowed with beautiful natural landscapes and rich cultural and archaeological heritage, and remains the main source of the nation's drinking water, there are visible signs of the 'carrying capacity' being undermined. However, the LCZ is suffering from uncontrolled urban sprawl and

unplanned, development exemplified by beach complexes, landfills, breakwaters, and marinas, which hinder public access to the seashore. Similarly, incompatible coastal land-uses with polluting industries located next to residential and commercial developments, are abound. The problem is further compounded by unregulated ribbon development along coastal access roads and traffic arteries.

It is the view of the authors that unless attitudes are changed, the biophysical environment of Lebanon is likely to be overwhelmed with rapid and unregulated growth and development. Nevertheless, the authors do not expect Lebanon to reinvent the wheel, as there are countries that have gone through this phase of sustainable development.

METHODOLOGY

A questionnaire to reveal the extent of sustainable building practices in Lebanon was designed and distributed through the Internet to targeted number of architects and construction professionals. The aim of which was of twofold; firstly to understand the level of awareness, and level of implementation of sustainability issues amongst built environment professionals in Lebanon, and secondly, to understand possible barriers to changing of attitudes towards sustainable practices.

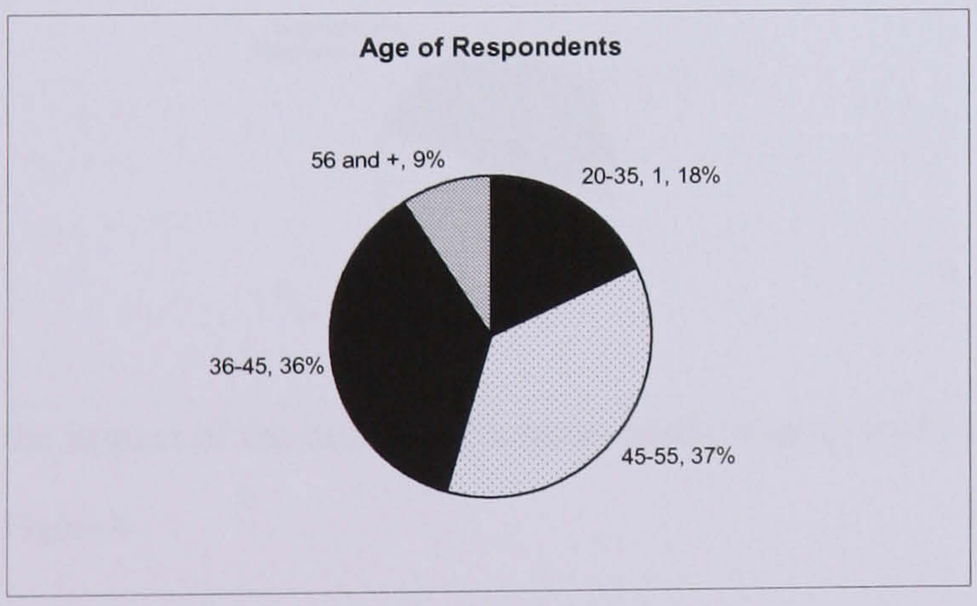
The 100 most successful architectural practices and construction firms were selected. The rational being that if sustainability culture exists in Lebanon's built environment sector, it should noted with these firms that are at the forefront of the nation's physical development. The questionnaire was divided into four different sections to reveal the characteristics of respondents, their sustainability awareness, barriers to changing of attitudes, and respondents' view on strategy and policy.

The questionnaire was sent out in the middle of July and after three weeks only 40 questionnaires were returned, representing 40 percent response rate. Apart from the fact that the incidence of low response rate to research question is typical of the construction industry, the situation in Lebanon at the time may also have contributed. It was during this period that the former Lebanese Prime Minister, Mr Rafic Hariri was assassinated. Assassinations of a seasoned journalist, Mr Samir Kassir, and the former head of the communist party soon followed. This created huge political tension and many people remained in-doors for a while before venturing into offices and other places of work. It is however hoped that the effects on our results and hence conclusions and recommendations would be minimal.

ANALYSIS OF RESULTS

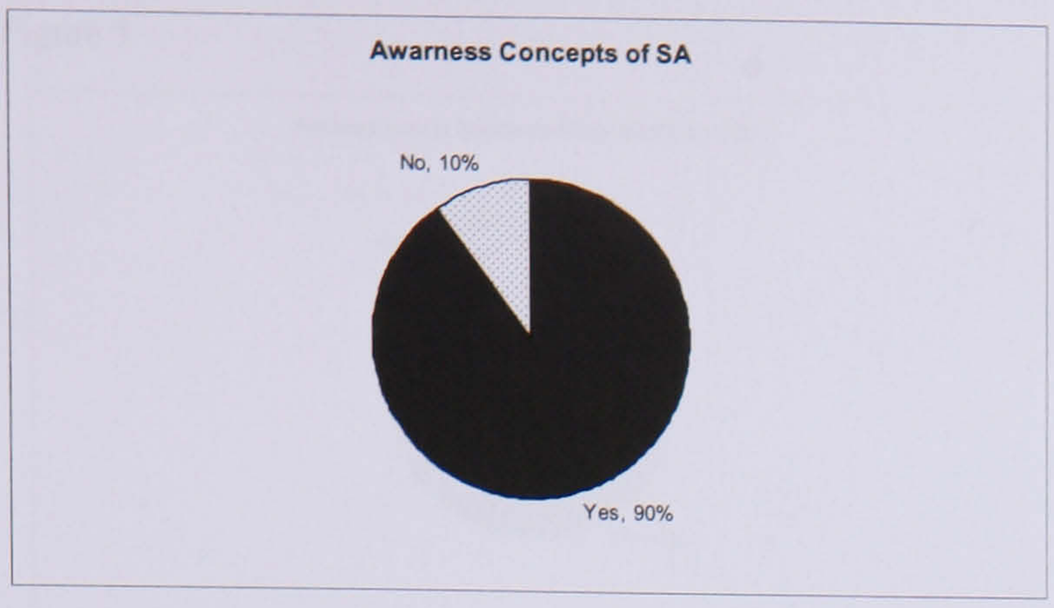
The result shows that the respondents are diversified and vary in ages. It is interesting to note that 73% of respondents ranged between 36 and 55 years of age, while 18% range between 20 and 35 years and only 9% were above 56 years. (Figure 1)

Figure 1



Almost all of the respondents showed profound awareness of the adverse environmental impact of the built environment form, especially the depletion of natural resources and pollution of the biophysical environment.
As Figure 2 shows, 90% of respondents are aware of the concept and importance of sustainability issues.

Figure 2



Finding out the sources of awareness for the concept of sustainable development amongst respondents was important. It is interesting that 50% of respondents learned about the concept of sustainable development in their university education, while the other 50% became aware of the concept from personal interests.

The views of the impact of the built environment on the biophysical environment vary. According to Figure 3, 34% emphasised the impact on natural resource depletion, while 30% emphasised the pollution impact, and 24% dwelled on the impact on human health and comfort.

Figure 3

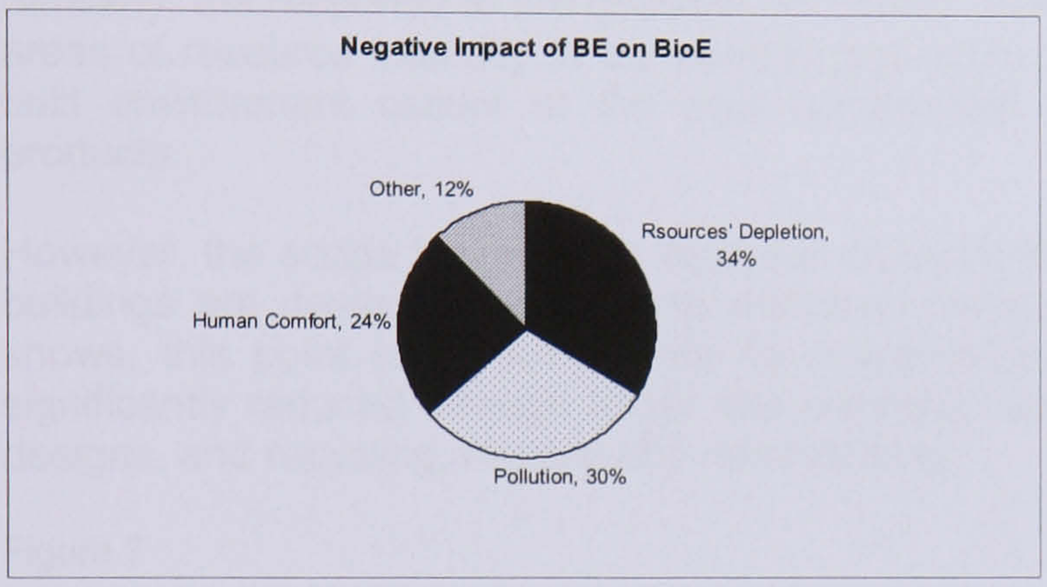
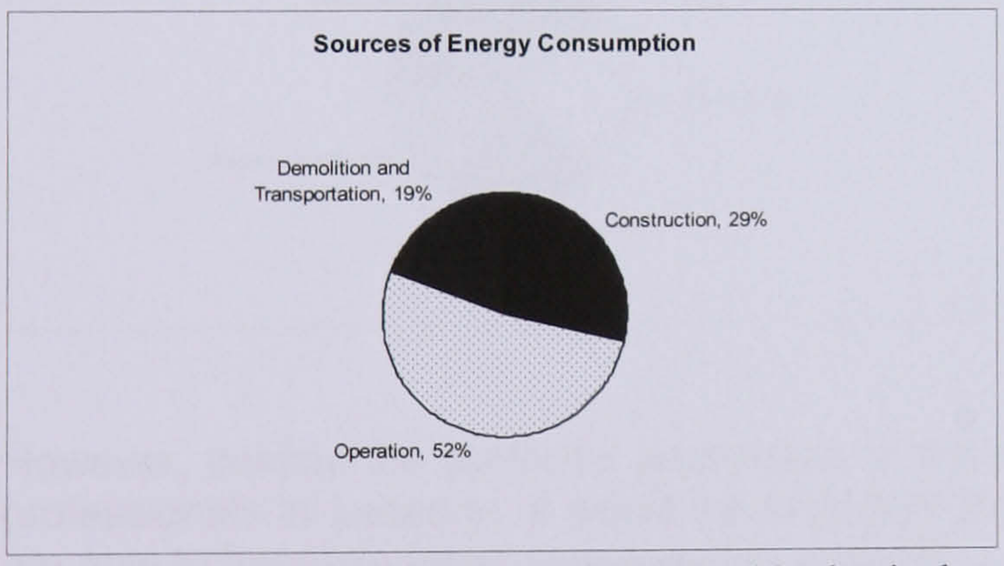
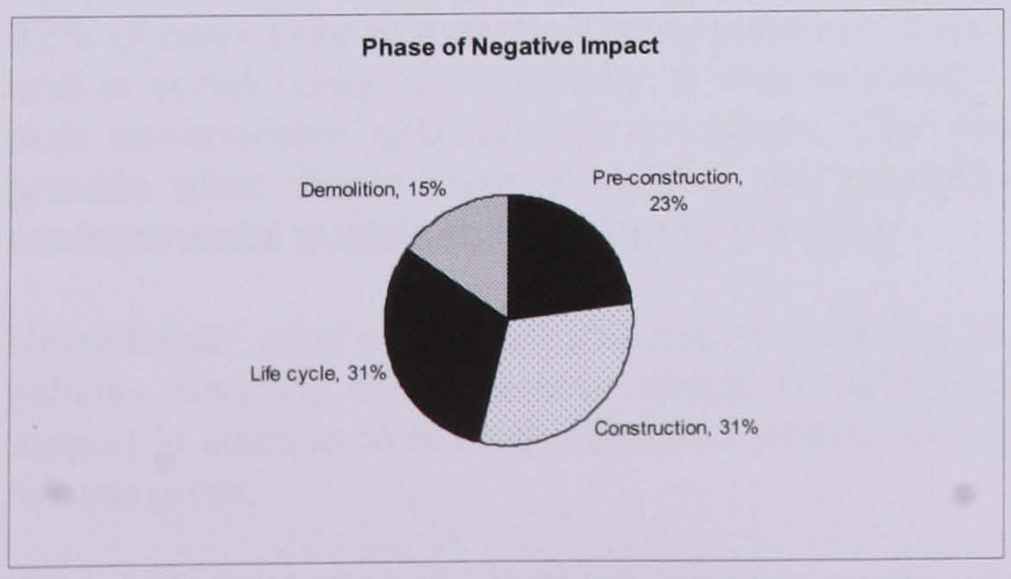


Figure 4 shows the areas of the construction process where respondents believe the impact the most on the biophysical environment occur. Accordingly, 62% of respondents believe that the most negative impacts of the built environment occur at the construction phase and through out the life cycle of the construction product. This is significant given that it is possible to proactively intervene at the design stage of construction products to minimise



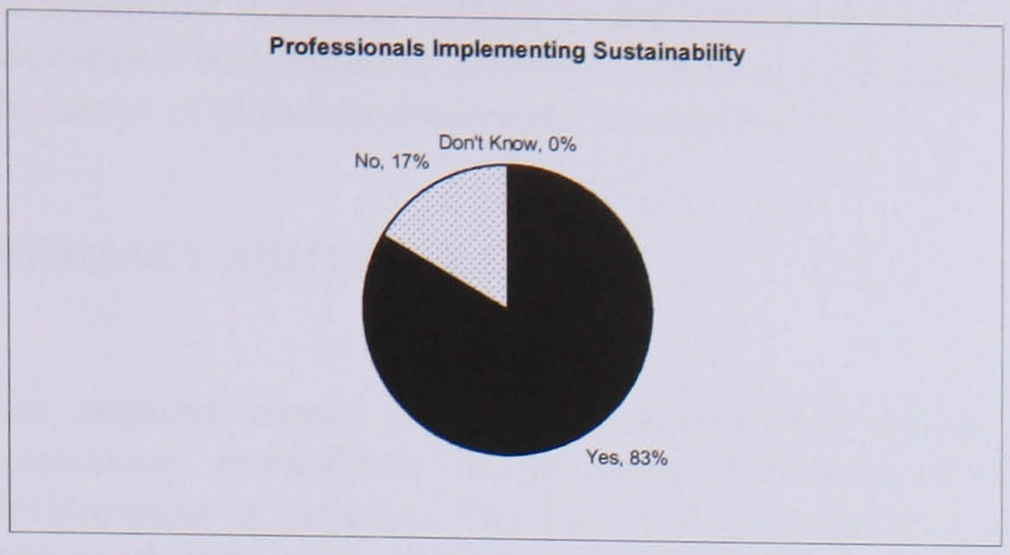
the impact of the built environment on the biophysical environment.

Figure 4



Additionally, construction products designed with a view to sustainability can have significant impact on construction activities at the demolition stage of the building. The realisation of this fact has resulted in huge emphasis on sustainable architecture and sustainable built environment generally.

Figure 5

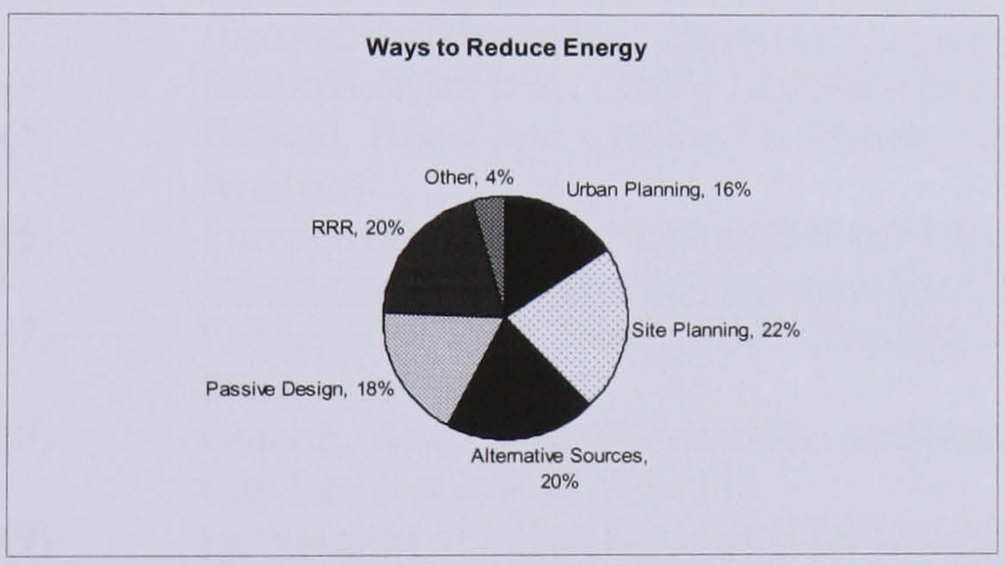


The goal of sustainable architecture is to find design solutions that consider the relationship between the health of the natural environment, the built environment, and the people. Three principles underpin sustainability in Architecture and these include resource efficiency, life cycle strategies, and responsible design that seriously respects the environmental quality in and around their built environment (site, neighbourhood, cities, regions, etc.), and ensuring human comfort. Sustainable architecture, have the potential to minimise the huge demolition wastes from the sector. This is particularly the case where buildings can be designed and built such that they are easily be demolished and components recycled and reused.

Similarly, the response to the question on energy consumption is instructive on respondents' perception of areas of resource intensity in the construction process. More than half of total energy consumed in the built environment occurs at the post construction stage used for running or operating construction products.

However, the scope for reducing resource consumption in the built environment is huge, especially when buildings are designed to consume minimum energy and other non-renewable resources. As Figure 7 shows, this point is explicitly made by respondents that energy use in the built environment can be significantly reduced through better site planning, designs incorporating alternative material use, passive designs, and recycling, reusing and rehabilitating.

Figure 7



However, despite the profound awareness of the concept of sustainability admitted by built environment professionals in Lebanon, it would be important to know why only 36% of built environment practitioners are able to translate these concepts into projects.

Most respondents highlight clients' preferences as the major explanation for low sustainable practices. The sentiments repeated again and again are one of "if the client is able to pay". The revelation by a massive 82% of respondents that the implementation of such measure is mainly possible in private funded projects and in some cases in regionally or internationally funded projects emphasises the importance placed by built environment practitioners on clients. The message is that built environment practitioners can only provide what clients want, indicating that educating clients on the significance and importance of global environmental sustainability is vitally important.

Nevertheless, other constraints identified include lack of governmental policies to enforce and implement sustainable policies. Similarly, carelessness in relation to environmental issues, lack of information, education, training, technical support in addition to the lack expressed interest from the clients, due to the preliminary cost are some of the other reasons given.

When asked whether, as built environment professionals, they would change attitudes and approaches towards sustainability and 100% of our respondents responded positively. However, 90% agreed that building rules and standards coupled with economic incentives are necessary to encourage both built environment professionals and clients to adopt sustainable measures. Proactive educational programs to build capacities and awareness towards these issues is also essential.

One respondent added "the problem of promoting sustainable architectural design and caring for environmental sustainability is closely related to the introduction of sustainability curricula in schools, colleges and other higher educational institutions in Lebanon. The media also has fundamental roles in the sensitisation of the general public to the issues of global environmental sustainability".

SUMMARY AND CONCLUSIONS

The negative impact of the built environment on the environment is established. To avoid important future correctional expenditure in the future, principals of sustainable development should inform built environment development in Lebanon. The past is only looked at as material to learn from, aiming at finding solutions that take into consideration the wellbeing of the natural environment, the strength of the built environment, and the health of the people living in this environment. Resource efficiency, life cycle strategies, and sustainable designs, are imperatives to achieving global environmental sustainability. This is only possible only when all stakeholders proactively commit to the principles of sustainable built environment and pursued holistically to embrace the economic, social and the environmental dimensions to sustainable built environment and development.

Changing attitude would mean reducing non-renewable resources' consumption (water, fuel, etc.) and reliance on renewable resources and passive design strategies. Sustainable design strategies should become an important part of urban planning and site planning projects (orientation of buildings, passive design strategies, etc.). Urban policies and sustainable design standards and guidelines, combined with incentives in favour of reducing non-renewable resources consumption and implementing these strategies, will encourage and enhance stakeholders' capacity to adopt sustainable practices. Education, capacity building, and awareness campaigns are essential to inform stakeholders in Lebanon on the long-term benefits of sustainable built environment and development in order to solicit their full co-operation.

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Appendix 6

QUESTIONNAIRE

I am a PhD student at the De Montfort University, Faculty of Art and Design, Leicester School of Architecture, Leicester, United Kingdom. The study is performed as a partial fulfilment of the requirements for my PhD.
This questionnaire is designed to help me in the ongoing research looking at the sustainable rehabilitation of the built environment, focusing on the area of Zouk Mosbeh. The ultimate objective of this research is to propose effective and clear recommendations to form a guideline for sustainable rehabilitation of Lebanon's built environment.

The questions from sections 1- 6 will tackle the following information:

6. Background of the household
7. Income Status
8. Consumption patterns (water, and electricity)
9. Disposal patterns (water waste and solid waste)
10. Comfort (thermal, air quality, etc.)
11. Awareness and Participation

Note that your household has been chosen randomly. No special knowledge is required to answer any of the questions and all information provided will be treated in the strictest confidence. Please would you fill in the questions below ticking the appropriate box relevant to your case?

Thank you for participating.

.....

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Section 1: Background of the household.

1. Age: a) 20 - 24 ... b) 25 - 29 ... c) 30 - 34... d) 35 - 39 ... e) 40 +...

2. Sex: a) Male ... b) Female...
3. Status: a) Married... b) Single... c) Other (please specify)...
4. What is you educational background?
    a. No formal education...
    b. Primary level...
    c. Secondary level...
    d. Graduate level...
    e. Other (please specify)...
5. You are originally from Zouk Mosbeh (ZM) a) yes b) no
6. If your answer is "no" where do you come from?
    a. South Lebanon...
    b. South Beirut...
    c. Central Beirut...
    d. North Beirut...
    e. North Lebanon...
7. Why did you choose to settle in ZM (please specify the year)?
    a. Because I knew people there...
    b. Because I had no option...
    c. Because I cannot afford housing in other areas ...
    d. Because of the war
    e. Other (please specify)...

Section 2: Income Status.

1. How many household members are in full time work (30+ hours a week)?
    a. 1
    b. 2
    c. 3
    d. 4

    Please specify if more than 4...
2. What is the nature of your work?
    a. (Civil Servant or Public Employee)...
    b. (Private Employee)...
    c. (Self-Employee)...
    d. (Other - Please Specify)...
3. What is your total monthly income (including the income of other family members)?
    a. Up to USA$ 300...
    b. From USA$ 300 - To USA$ 500
    c. From USA$ 500 - To USA$ 800
    d. From USA$ 800 - To USA$ 1200
    e. Over USA$ 1200
4. How many children you have at school?
    a. 1...
    b. 2...
    c. 3...
    d. 4...
    e. More than 4...
5. They are in: a) public school b) private school
6. How many rooms is your house (bed+living+sitting+Kitchen)?
    a. Less than 4...
    b. 4...
    c. 5...
    d. 6...
    e. More than 6...

7. Describe your house a) Owned... b) Rented... c) Other (please specify)...

Section 3: Consumption Patterns (water and electricity)

1. Do you receive public water in your house? a) Yes b) No
2. If your answer is "no", please specify why:
    a. You are not connected to the public water supply...
    b. Although you are connected you do not receive water...
    c. Other - Please specify
3. What is the yearly rate you pay for public water disposal?
    ---------- USA $ per month
4. Do you drink from public water supply? a) Yes b) No
5. If your answer is "No", how do you manage?
    a. Purchase bottled water...
    b. Fill in water tanks from a font...
    c. Other (please specify)...
6. Do you also purchase water from private distributor? a) Yes b) No
7. How often?
    a. Once a week...
    b. Twice a week...
    c. More than twice a week...
8. What is your average spending on private water distribution per month?
    ---------- USA$ per month
9. Do you receive regularly electricity from the public grid? a) Yes b) No
10. If your answer is "No", how often?
    a. Less than six hours a day...
    b. Six hours a day...
    c. Twelve hours a day...
    d. Other (please specify)...
11. How do you manage during electricity cuts?
    a. I am connected to a private generator...
    b. I have a private generator...
    c. I have an Ultra Power Supply System...
    d. Other (Please specify)
12. Please tick the box for the electric energy appliances you have in your home:

a	Radio	...
b	Electric fan	...
c	Refrigerator	...
d	Television	...
e	Video Equipment	...
f	Electric Iron	...
g	Electric heaters	...
h	Air conditioner	...
i	Other (Please Specify)...	...

13. What is your average monthly consumption of electricity? (Kilowatt-hours/month)
    ---------- Kilowatt-hours/month

14. What is your average spending on public grid electricity per month?
    ---------- USA $ per month

15. What is your average spending on generator electricity per month?
    ---------- USA $ per month

Section 4: Disposal Patterns (water waste and solid waste)

1. Do you know where does your water waste go? a) Yes b) No
2. If your answer is "Yes", were does your water waste go?
    a. Municipal sewage system...
    b. Underground septic tank...
    c. Underground pit...

d. Other (please specify)...

3. What is the yearly rate you pay for municipal water waste sewage system?
   ---------- USA $ per month
4. Do you know where does your solid waste go? a) Yes b) No
5. How do you dispose of your solid waste?
   a. Mixed waste outside my door...
   b. Mixed waste in disposal bin...
   c. Separated waste outside my door...
   d. Separated waste in appropriate bins...
   e. Other (please specify)
6. What is the yearly rate you pay for municipal solid waste collection?
   ---------- USA $ per month

Section 5: Comfort (thermal, air quality, etc.)

	Time/Date	T °C	% RH	m/s	MRT°C	Clo[1]				Met[2]				
Winter						0.1-0.5	0.6-0.7	1-1.5	3-4	0.7-1.2	2.7-	3	4.3	5.4
Mid-season						0.1-0.5	0.6-0.7	1-1.5	3-4	0.7-1.2	2.7-	3	4.3	5.4
Summer						0.1-0.5	0.6-0.7	1-1.5	3-4	0.7-1.2	2.7-	3	4.3	5.4

1. Please indicate in the scale below how you feel now:

	Cold	Cool	Slightly Cool	Neutral	Slightly Warm	Warm	Hot
Winter							
Mid-season							
Summer							

2. Please indicate in the scale below how you would like to feel now:

	Cold	Cool	Slightly Cool	Neutral	Slightly Warm	Warm	Hot
Winter							
Mid-season							
Summer							

3. Are you generally satisfied with your thermal environment? a) Yes b) No
4. Please indicate in the scale below how you rate the air quality in your area:
   a. Unsatisfactory
   b. Satisfactory
   c. Good
   d. Very good
   e. Excellent
5. What are the causes of such discomfort?
   a. Construction sites...
   b. Industries...
   c. Power plant...
   d. Traffic...
   e. Generators...
   f. Other (please specify)
6. In what form is the discomfort manifested?
   a. Dust...
   b. Smokes...
   c. Particulates...

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[1] Clothing coefficient are deduced from Moore, 1993 (p. 35)
[2] Metabolism rates are deduced from Moore, 1993 (p.36)

d. Bad odors...
e. Other (please specify)...

7. Would you say that noise is a major problem in the area? a) Yes b) No
8. If your answer is "Yes", what are in your opinion the causes?
   a. Construction sites...
   b. Industries...
   c. Power plant...
   d. Traffic...
   e. Generators...
   f. Neighbors...
   g. Other (please specify)

Section 6: Awareness and Participation

1. Do you think it is possible to reduce energy consumption? a) Yes b) No
2. If your answer is "Yes", please indicate the way to do so:
   a. Install solar heating instead of the existing electrical heating...
   b. Install energy saving light bulbs instead of normal bulbs...
   c. Apply insulating materials internally or externally avoiding energy loss in heating or cooling...
   d. Use of greening around the house (deciduous plants)...
   e. Other (Please specify)...
3. Would you adopt energy saving methods (ESM)? a) Yes b) No
4. If your answer is "No", please pick one of the below:
   a. I did not know about this...
   b. I cannot afford it...

c. It will take too long to take the money, used for changing devices, back...
   d. It will mean I cannot afford other things (holidays, cars, clothes, etc)...
   e. I have no time to do it...
   f. Other. (Please specify)

5. Are you willing to pay for utility services such as water, electricity, sewage, and so on if introduced on your plot? a) Yes b) No

6. Are you familiar with the concept of waste recycling? a) Yes b) No
7. Do you know about the recycling bins placed in the area? a) Yes b) No
8. Were you informed? a) Yes b) No
9. Are you generally satisfied with this place you are living in? a) Yes b) No
10. Which other place would you like to go if you were to leave this place immediately?
    a. I have no idea were to go to...
    b. To another area with better facilities...
    c. To another less polluted area...
    d. Other (please specify)...
11. What is your impression about different municipalities attitudes towards this area?
    a. The municipality did nothing to improve the areas' conditions...
    b. The municipality attempted to improve the areas' conditions...
    c. The municipality always promises to improve the areas' conditions...
    d. Other (Please specify)
12. What should the municipality do to improve the area?
    a. Draft a master plan for the area...
    b. Upgrade the infrastructures...
    c. Give incentives to the community to upgrade their buildings...
    d. Inform and involve residents in the decision making...
    e. Other (Please specify)

Appendix 7

The data below, related to the municipal area of Zouk Mosbeh (ZM), was collected during an interview with the head of the housing taxes' collection office, and the president of the land value committee of ZM municipality. The latter being also the secretary of ZM municipal committee. This interview took place in the municipality of ZM on August 1, 2007.

Sectors[1]	Land-use	Landownership	Lots	Empty lots	Built lots	Buildings
1	Industrial +Tourist	Private	104	42	62	75
2	Residential	Private	346	99	247	265
3	Residential	Private	326	89	237	244
4	Residential +Industrial	Private	239	84	155	181
5	Residential	Private	184	59	125	154
6	Residential +Industrial	Private	365	193	172	216
7	Residential + Green	Private + Waqf[2]	123	103	20	28
8	Residential +Cultural +Religious + Green	Private + Waqf	87	73	14	47

Total # of Lots in ZM	1774	100%
Total # of Empty Lots in ZM	742	42%
Total # of Built Lots in ZM	1032	58%
Total # of Buildings/Houses	1210	
Total # of Houses/Flats	Approx. 11.000	

Total # of Residents in ZM	Approx. 55.000 to 60.000
Total # of ZM Original Residents	Approx. 5000
Total # of Residents with the Legal Right to Vote in Municipal Elections	Approx. 1700 equivalent to 19% of ZM residents

[1] Concerning sectors' map refer to Appendix 3

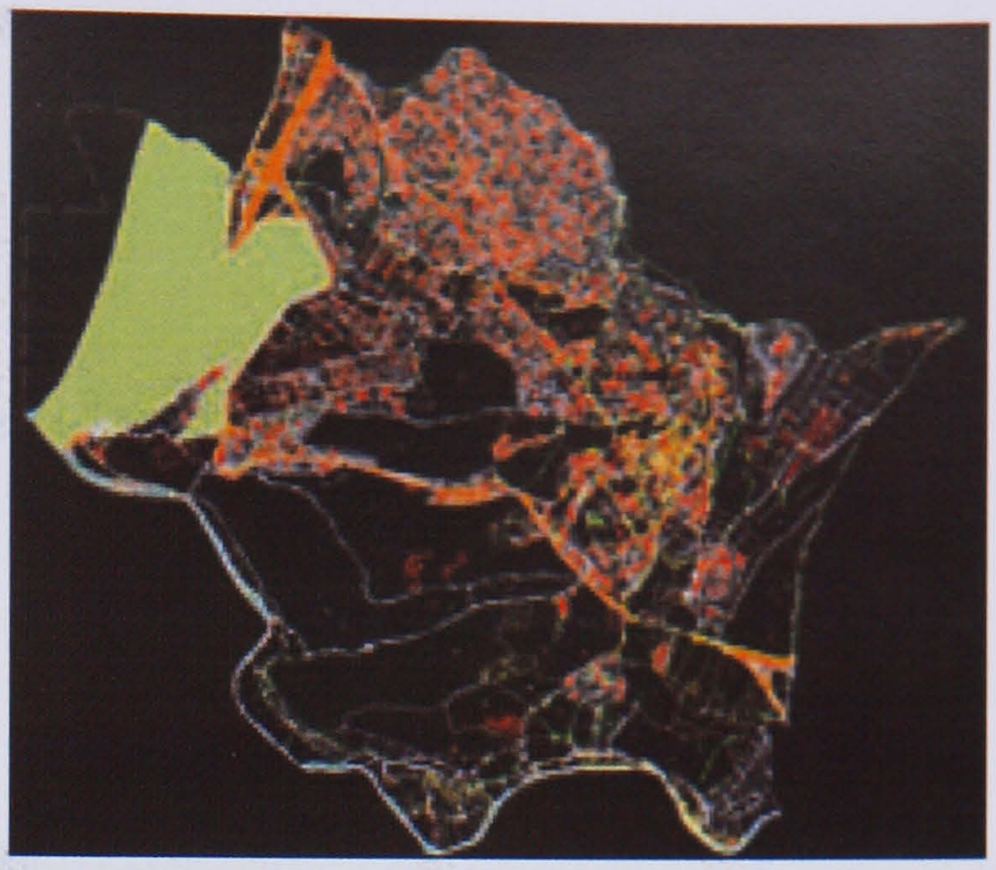
[2] Waqf is a religious endowment, a property giving revenues, as regulated by Islamic law. In Lebanon, following independence, only non-Muslims were included in a 1951 law enumerating officially recognized sects in the following order: Maronites, Greek Orthodox, Greek Catholics, Armenian Orthodox (Gregorian), Armenian Catholics, Syrian Orthodox (Jacobites), Syrian Catholics, Chaldean Catholics, Nestorian Assyrians, Latins (Roman Catholics), Protestants, and Jews. The law specified that each sect was free to manage its Waqf (religious endowment) properties, as well as its personal status laws for its members. (http://countrystudies.us/lebanon/41.htm).

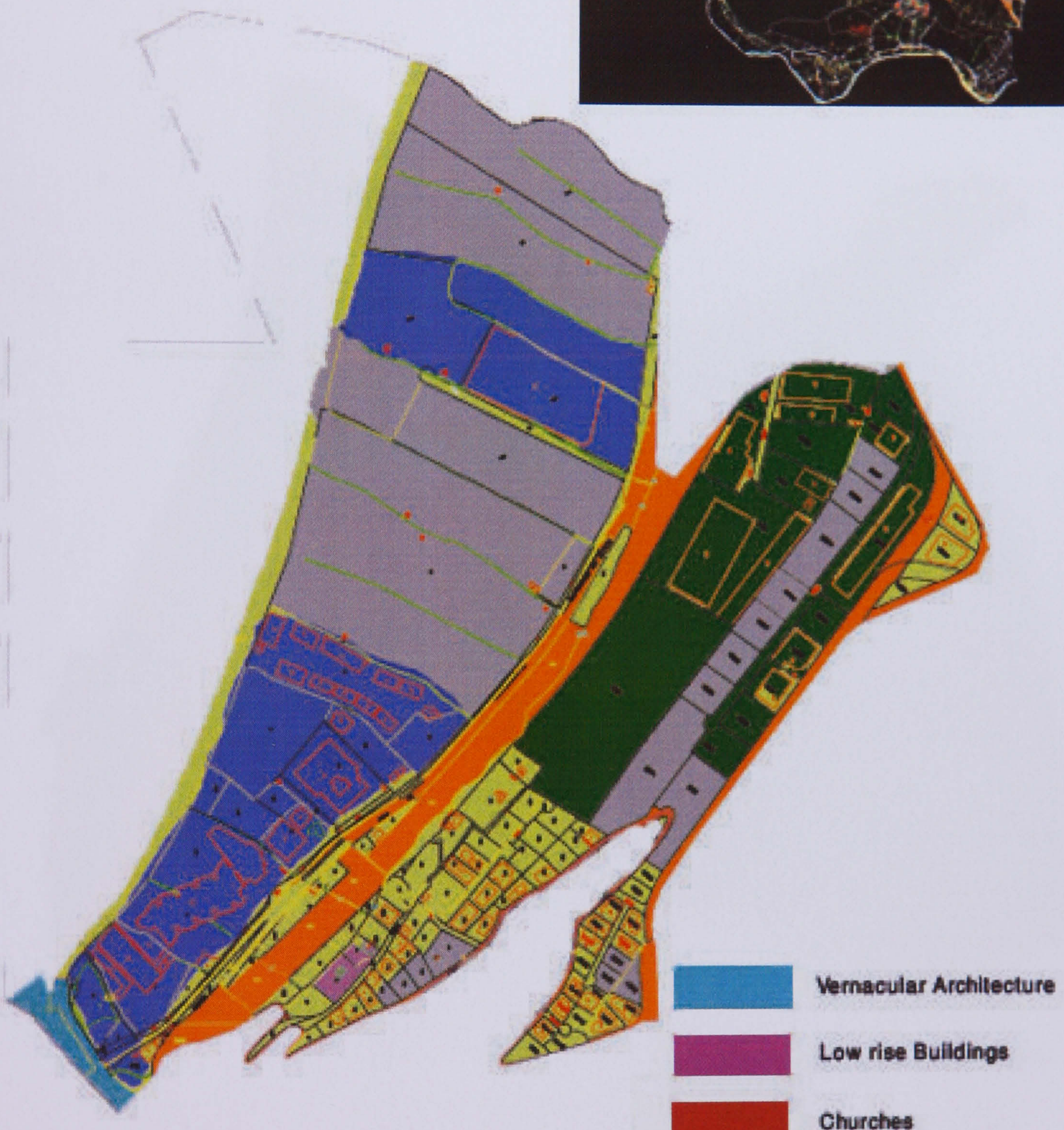
Appendix 8

The following 8 sheets describe the land use for each of the 8 sectors of Zouk Mosbeh. The sectors are considered as per the Municipal sectors' map produced by the Municipality of Zouk Mosbeh and attached in appendix 3.

The data was collected through site observations. Focus was on Traditional (vernacular), low rise and medium rise residential buildings.

Appendix 8 Sector 1





Vernacular Architecture

Low rise Buildings

Churches

Industrial Buildings

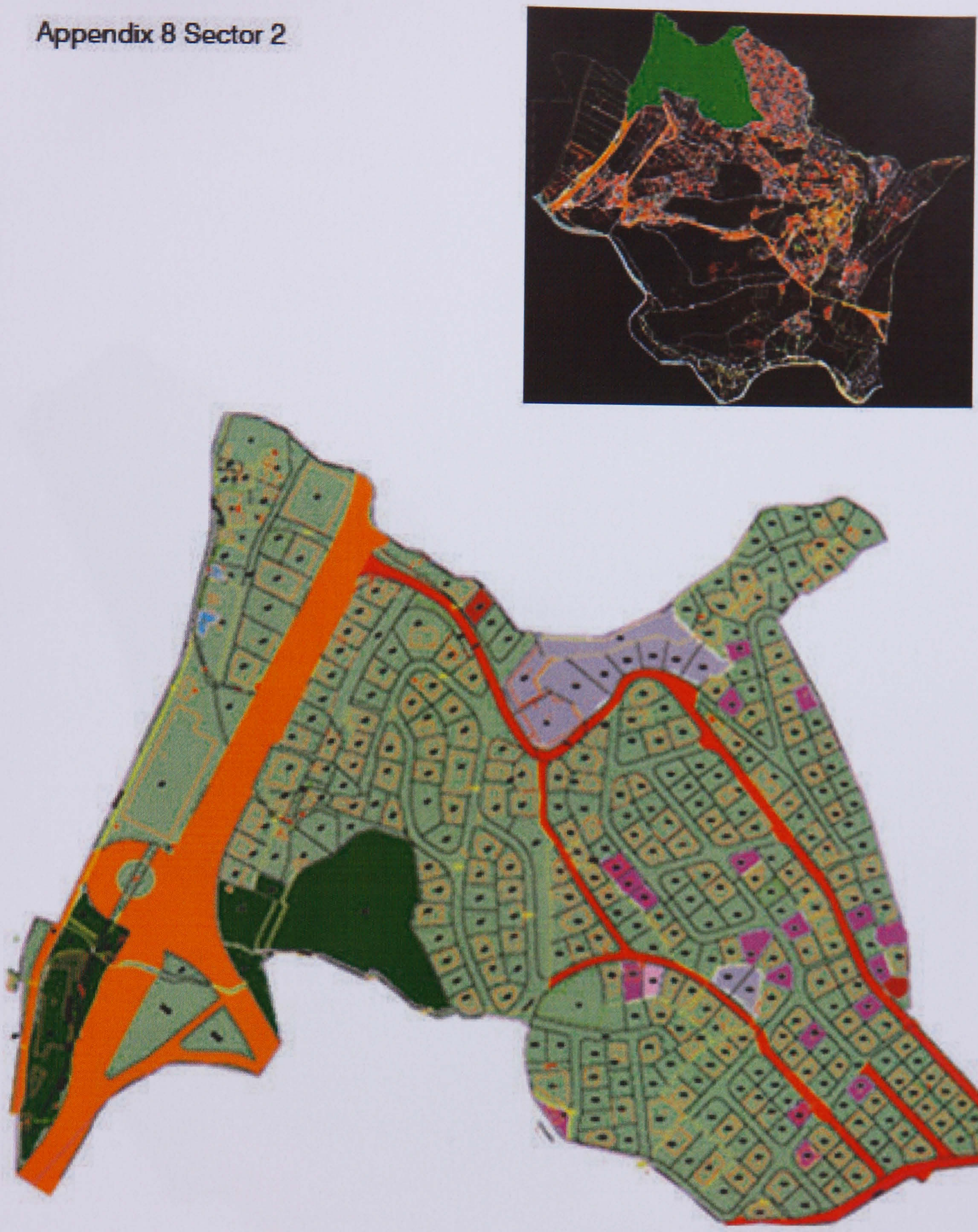
Green Areas to be built

Excavated for Building Purpose

Summer Resorts

Medium rise Buildings

Appendix 8 Sector 2



Vernacular Architecture

Low rise Buildings

Churches

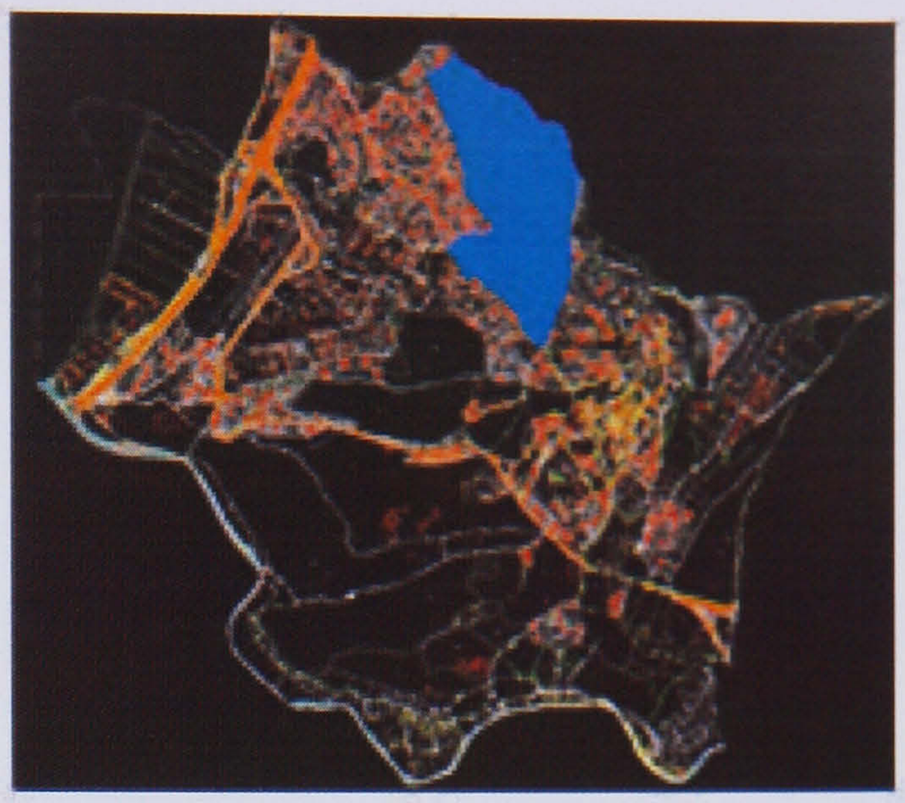
Industrial Buildings

Green Areas to be built

Excavated for Building Purpose

Medium rise Buildings

Appendix 8 sector 3



Vernacular Architecture

Low rise Buildings

Churches

Industrial Buildings

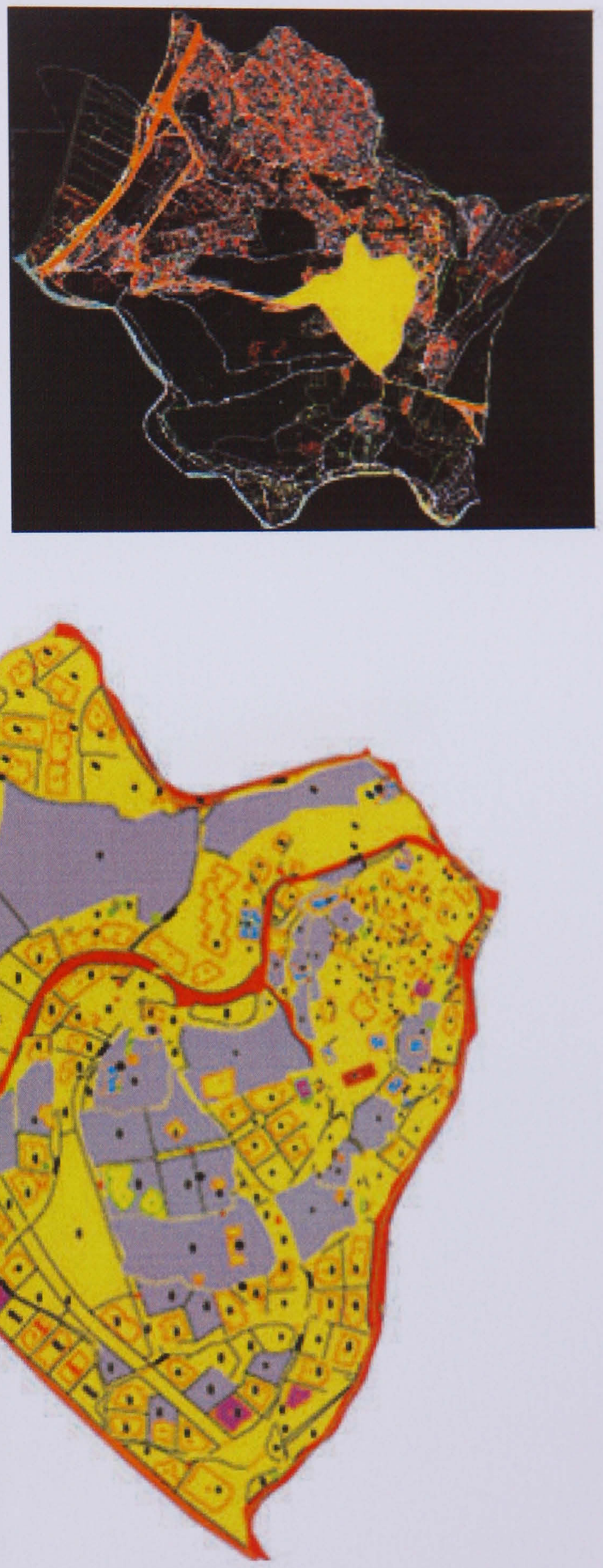
Green Areas to be built

Excavated for Building Purpose

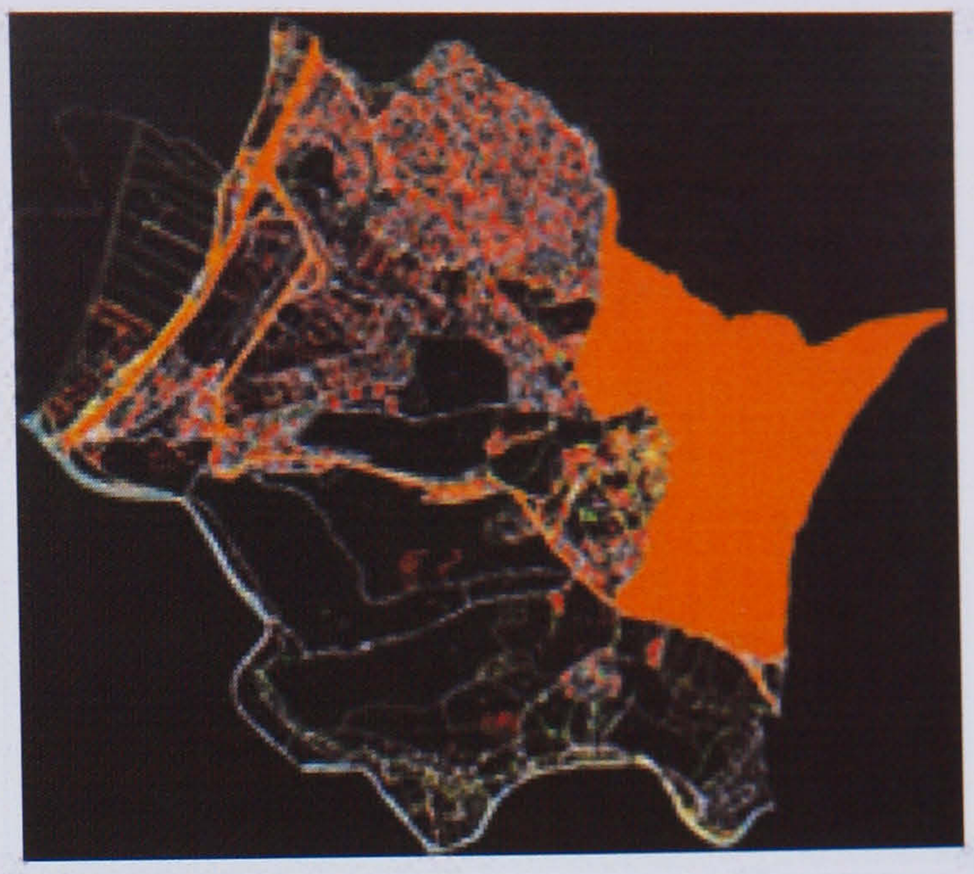
Medium rise Buildings

Appendix 8 Sector 4

Appendix 8 Sector 5



Appendix 8 Sector 6



Vernacular Architecture

Low rise Buildings

Churches

Industrial Buildings

Green Areas to be built

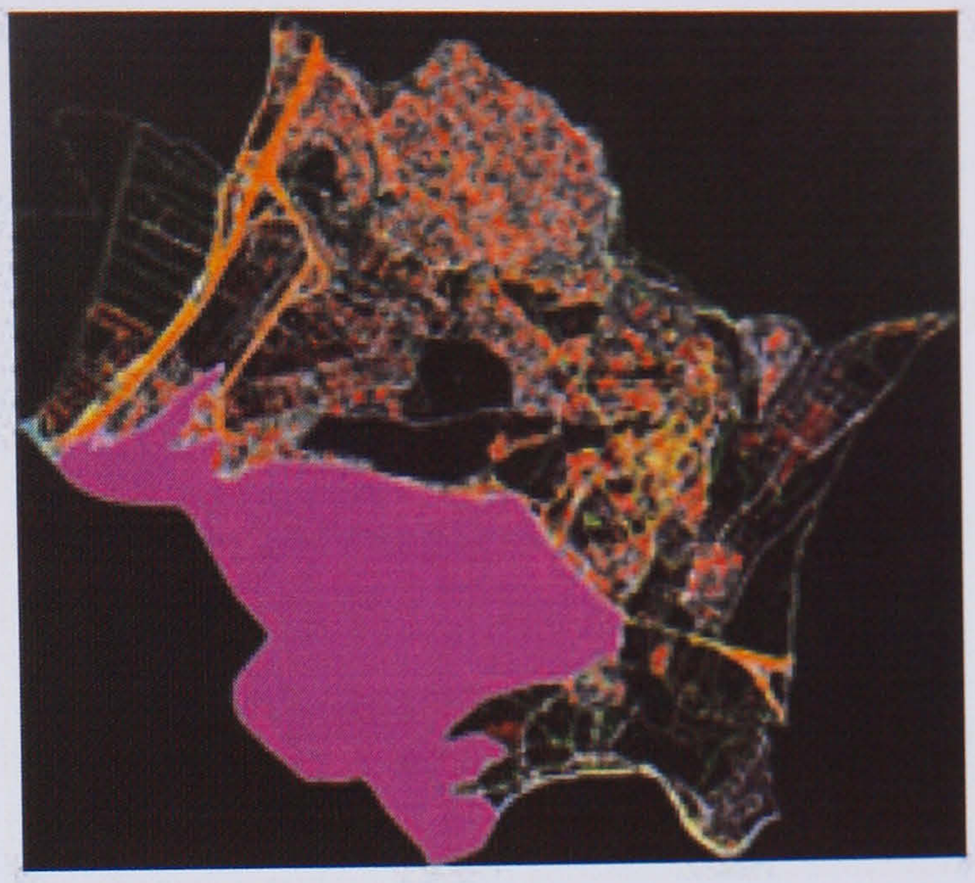
Excavated for Building Purpose

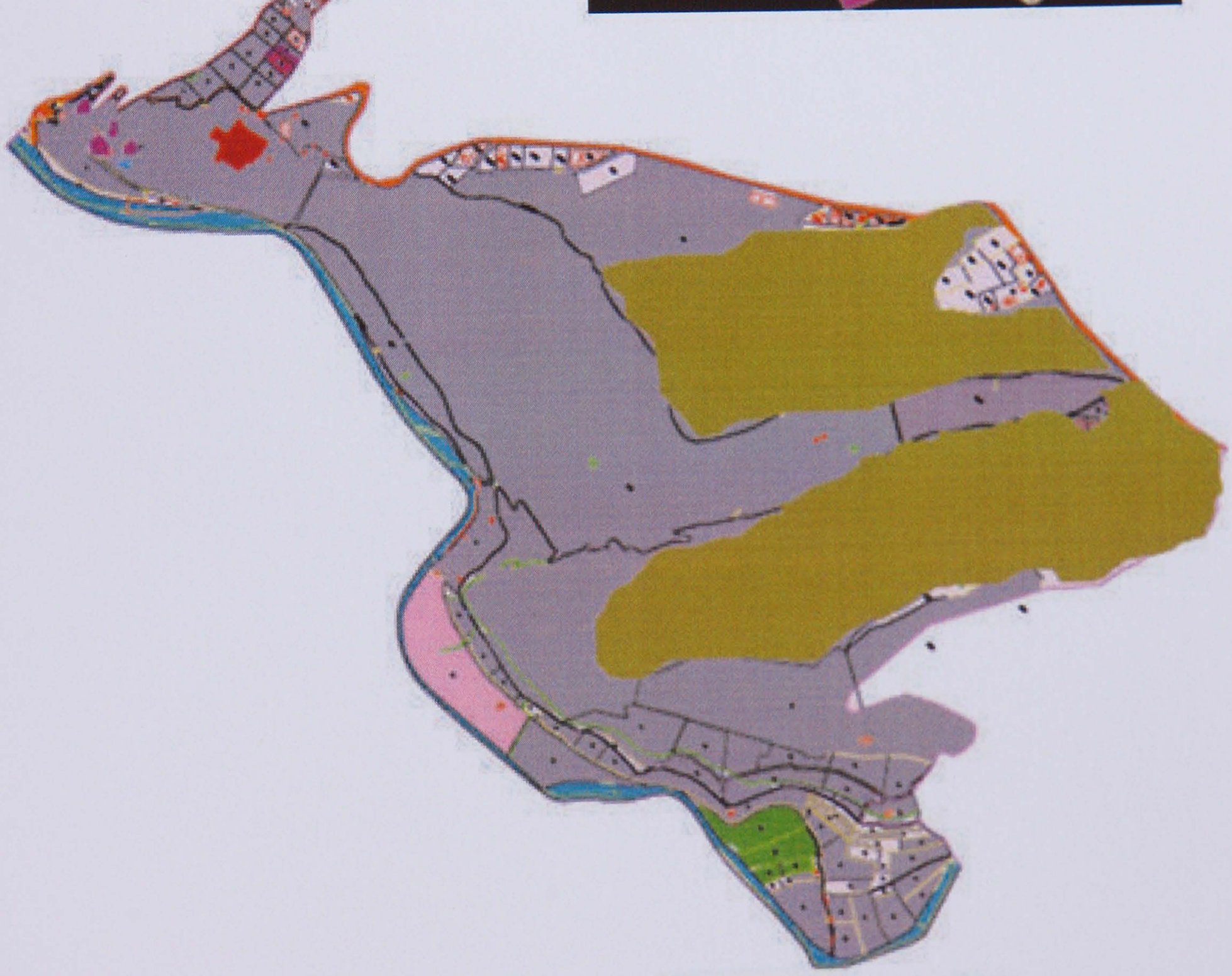
Medium rise Buildings

Appendix 8 Sector 7

- Vernacular Architecture
- Low rise Buildings
- Churches
- Industrial Buildings
- Green Areas to be built
- Excavated for Building Purpose
- Commercial Activities
- Medium rise Buildings

Appendix 8 Sector 8





Vernacular Architecture

Low rise Buildings

Churches

Cultural -universities and schools

Green Areas to be built

Excavated for Building Purpose

Leisure

Medium rise Buildings